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February 1996

US Army Corps of Engineers
Waterways Experiment Station

Buffalo River Dredging Demonstration

by Daniel E. Averett, Paul A. Zappi, Henry E. Tatem, Anthony C. Gibson, Elizabeth A. Tominey, Natale S. Tate, Sherry L. Graham, WES

B. Thomas Kenna, Stephen M. Yaksich, Buffalo District

Prepared for U.S. Army Engineer District, Buffalo

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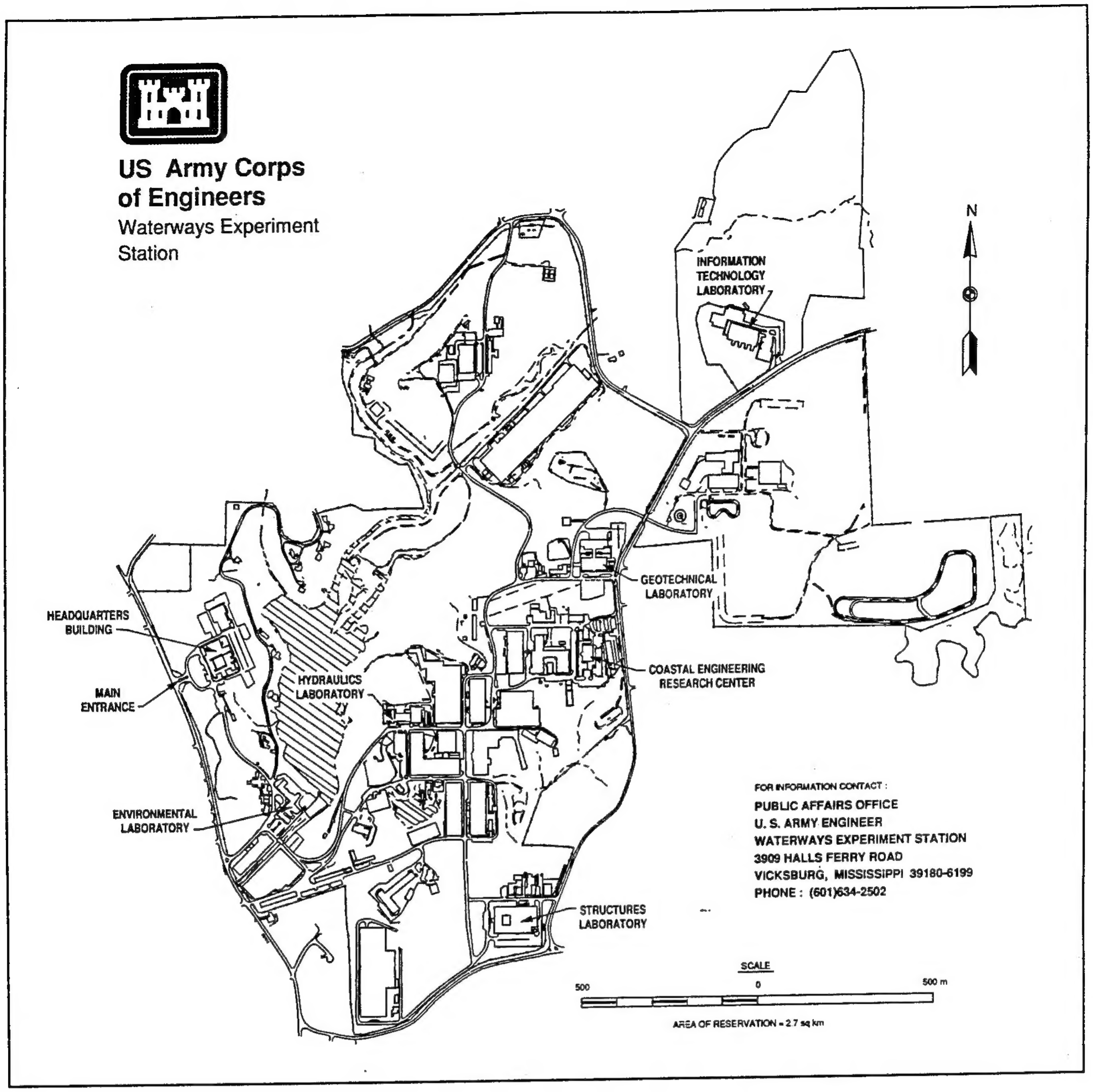

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Contents

Preface

The field study and evaluations described in this report were sponsored by the U.S. Army Engineer District, Buffalo (CENCB), under the direction of the 1992 Energy and Water Development Appropriations Bills.

Field study design, data analyses, and report preparation were performed by the Environmental Restoration Branch (ERB) and Engineering Applications Branch (EAB), Environmental Engineering Division (EED), Environmental Laboratory (EL), and the Fate and Effects Branch (FEB), Environmental Processes and Effects Division, EL, at the U.S. Army Engineer Waterways Experiment Station (WES) in Vicksburg, MS. Mr. Daniel E. Averett, ERB, was WES project manager and Mr. B. Thomas Kenna was CENCB project manager. This report was prepared by Mr. Averett, ERB; Mr. Paul A. Zappi, EAB (currently employed by Radian Corporation, Baton Rouge, LA); Dr. Henry E. Tatem and Ms. Elizabeth A. Tominey, FEB; Mr. Kenna, CENCB; Mr. Anthony C. Gibson, Ms. Natale S. Tate, and Ms. Sherry L. Graham, EAB; and Dr. Stephen M. Yaksich, CENCB. The contributions of Mr. Allen M. Teeter and Mr. Stephen H. Scott, Hydraulics Laboratory (HL), WES, and Dr. Paul R. Schroeder, Mr. David R. Whitehead, Mr. James O. Farrel, and Ms. Kimberly M. Watson, EL, WES, are also acknowledged.

Appendix I, "Sealogger Water Column Data and Observations" and Appendix L, "Side-Scan Sonar Interpretation for the Buffalo River Dredging Demonstration," were prepared by Dr. Jill Singer, Buffalo State College, Buffalo, NY. Appendix M, "Dredged Material Transportation Barge Supernatant Clarification," was written by Ronald H. Church, Carl W. Smith, and Bernard J. Scheiner, U.S. Bureau of Mines, Tuscaloosa Research Center, Tuscaloosa, AL.

The Great Lakes Dredge and Dock (GLDD) Company (Cleveland, OH) owned and operated the dredge and transportation equipment under contract with CENCB. Mr. Richard L. Murphy was GLDD's field representative and dredge captain. Messrs. Averett, Kenna, and Zappi and Mr. Sidney Ragsdale, ERB; Mr. Don Arrington, ERB; Ms. Angela F. Scott, Estuarine Engineering Branch, Estuarine Division (ED), HL, WES; Mr. Christopher J. Callegan and Mr. Samuel E. Varnell, Estuarine Processes Branch, ED, HL, WES; Mr. Leo V. Koestler III, Data Acquisition Section, Operations Branch, Instrumentation Services Division, WES; and Dr. Jill Singer and Messrs.

Peter Behr, Glenn Luba, Scott Callen, Scott Fischer, and David Steckler, Buffalo State College (BSC) under contract with CENCB, participated in the field data collection. The water and sediment samples were analyzed by Applied Research Development Laboratory (ARDL), Inc., Mt. Vernon, IL, and Great Lakes Laboratory, Division of Environmental Toxicology and Chemistry, Center for Environmental Research and Education, BSC.

Work progressed under the general WES administrative supervision of Mr. Norman R. Francingues, Chief, ERB; Dr. Paul R. Schroeder or Mr. J. Craig Fischenich, Acting Chiefs, EAB; Dr. Raymond L. Montgomery, Chief, EED; and Dr. John W. Keeley, Director, EL. At the time of publication, the Director of WES was Dr. Robert W. Whalin and the Commander was COL Bruce K. Howard, EN.

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Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic yards	0.7645549	cubic meters
degrees (angle)	0.01745329	radians
Fahrenheit degrees	5/9	Celsius degrees or Kelvins[1]
feet	0.3048	meters
gallons	3.785412	cubic decimeters
horsepower (550 foot-pounds (force) per second)	745.6999	watts
inches	2.54	centimeters
microns	0.001	millimeters
miles (U.S. statute)	1.609347	kilometers
pounds (mass)	0.4535924	kilograms

[1] To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: C + (5/9) (F - 32). To obtain Kelvin (K) readings, use K + (5/9) (F - 32) + 273.15.

1 Buffalo River

The Buffalo River is located in eastern New York State's Erie County. The four major tributaries of the river include the Buffalo, Cayuga, and Cazenovia Creeks and the Buffalo Ship Canal (Figures 1 and 2). Portions of the creeks are fast flowing with rapids and low waterfalls. Buffalo and Cayuga Creeks originate in the Allegheny Plateau and flow northwest toward Lake Erie. Other creeks in the river's watershed include the Little Buffalo Creek (Cayuga Creek tributary), Hunter Creek (Buffalo Creek tributary), and the East and West Branch of Cazenovia Creek. The man-made Buffalo Ship Canal is located near the mouth of the Buffalo River (Figure 3).

The U.S. Geological Survey defines the head of the Buffalo River as the confluence of the Buffalo and Cayuga Creeks. The Buffalo River follows a tortuous path through the flatlands in the southern portion of the city of Buffalo and into Buffalo Harbor. The overall river length along its center line is about 8 miles.[1] Buffalo Harbor is located on the eastern shore of Lake Erie and near the head of the Niagara River, which flows northward into Lake Ontario. The Buffalo River watershed is roughly triangular in shape and has a drainage area of about 450 square miles, extending into Wyoming and Genesee Counties. Cayuga, Buffalo, and Cazenovia Creeks drain areas of 130, 150, and 140 square miles, respectively. These creeks receive runoff from agricultural, wooded, and residential lands. Industrial and municipal treatment plants and sewer overflows also discharge into these three creeks, the Buffalo River, and the Buffalo Ship Canal (New York Department of Environmental Conservation (NYDEC) and Buffalo River Citizens' Committee (BRCC) 1989).

The Buffalo River has a relatively small gradient of less than 1 ft/mile. Buffalo River water levels and conveyance are directly impacted by hydrologic conditions in the river's watershed and Lake Erie water levels. Long-term (yearly) lake water levels are dependent on climatic factors (e.g., rainfall, evaporation, runoff, etc.). Short-term (hourly or daily) lake water levels are affected by major atmospheric pressure lows and prevailing wind directions (lake levels near the harbor rise with westerly winds). At high discharges,

1 A table of factors for converting non-SI units of measurement to SI units is presented on page vii.

Buffalo River flow is down gradient; however, at medium and low discharges flow can be influenced by Lake Erie water levels (NYDEC and BRCC 1989; Raggio, Jirka, and Pacenka 1988).

Sediment yields from the Buffalo, Cayuga, and Cazenovia Creek drainage basins experience large seasonal variation, with yields about three times larger in summer than in winter. Although there are areas of localized scour, the Buffalo River is regarded as an aggrading river (exports less sediment past its mouth than is added by its tributaries and banks). River sediment trap efficiency varies inversely with river flow rates. Scouring generally occurs at channel constrictions (i.e., bridges, etc.) and during high flow events and deposition occurs in channel bends at low flow rates (Meredith and Rumer 1987; Raggio, Jirka, and Pacenka 1988).

In the 1950's many industrial, manufacturing, and petrochemical plants left the northeastern United States; in addition, transportation patterns changed with the advent of the St. Lawrence Seaway system, which links the Great Lakes to the Atlantic Ocean. These and other factors altered or ceased much of the industrial and commercial activity along the Buffalo River. Amid open spaces, inactive hazardous waste sites, and unused industrial structures, the Buffalo River area is still home to some viable industrial activity. Remaining industries bordering the river are involved in flour milling, cereal and grain processing, grain transportation and distribution, cement distribution, furniture making and refinishing, metal recycling (mainly junked automobiles), dye manufacturing, tire recycling, oil storage and dehydration, and sulfuric acid production (NYDEC and BRCC 1989).

Because of its continuing importance as a navigable waterway, the U.S. Army Engineer District (USAED), Buffalo continues to maintain navigable depths in the Buffalo River Channel and the Buffalo Ship Canal through dredging. The upstream limit of the Federal channel begins about 2 miles downstream of the Buffalo River's headwaters, at the Conrail Bridge, and extends to the Buffalo Harbor area, including the Ship Canal. The Buffalo River channel has a length of about 6 miles along its center line, covering a straight-line distance (headwaters to mouth) of only about 3 miles. The lower portion of the Buffalo River, below the Blue Tower Turning Basin (Figure 3), and the Buffalo Ship Canal, for a distance of approximately 1 mile upstream from its confluence with the Buffalo River, are maintained to a project depth of 22 ft below Lake Erie low water datum. The upper portion of the Buffalo River, above the Blue Tower Turning Basin, is maintained to a project depth of 21 ft below Lake Erie low water datum. Bottom channel widths are generally 150 ft in the Buffalo River Channel and 125 ft in the Buffalo Ship Canal (without dredging closer than 25 ft to dock lines except in channel bends). Natural side slopes are maintained at 1 vertical unit on 3 horizontal units. In recent years the river has been dredged every other year with the dredged material quantity in the 100,000- to 150,000-cu-yd range (USAED, Buffalo 1992a).

Buffalo River baseline stations originate at the mouth of the river and, although frequently diverted, extend along the river's shoreline to the upstream limit of the Federal channel. The upstream baseline station is 779+00.

River Water

Water bodies in New York State are classified by the NYDEC according to their best use in the interest of the public. These classifications are based on factors such as the character of bordering lands; stream flow; water quality; and past, present, and future water use. Water quality standards for each water class include specific quantities or ranges of parameters such as pH (acidity or alkalinity), turbidity, color, temperature, taste and odor-producing substances, bacteria, dissolved oxygen, and 95 toxic substances (including metals, organic compounds, and radioactive materials). When necessary, these classifications can offer a basis for restoring a water body (NYDEC and Buffalo River Citizens' Committee (BRCC) 1989).

The Buffalo River is currently classified for fishing (Class D) under the New York State stream classification system. This means that the river must permit "fish survival" but not necessarily "fish propagation." The NYDEC interprets "fish survival" to include the maintenance of a viable fishery (NYDEC 1989).

In 1987, a water quality monitoring station was installed by NYDEC on the Cayuga, Buffalo, and Cazenovia Creeks and on the Buffalo River. A comparison with Class A standards (best use drinking water) indicated that with the exception of iron, the mean contaminant values at all three creek stations met the established standards for the parameters measured. The high concentrations of iron in the creeks suggests the presence of naturally occurring iron in the watershed. Mean sample values at the Buffalo River station indicated general compliance with the current Class D designation and a high level of compliance with Class C/B standards. A few river samples exceeded Class D lead and mercury standards. Also, a few river samples exceeded Class C/B chromium, lead, mercury, and zinc standards and one sample exceeded pH standards. In addition to conventional water quality parameters, 43 volatile organic compounds were monitored and only 1 value (trichloroethene) was observed above detection limits (NYDEC and BRCC 1989).

River Sediment

Buffalo River drainage basin soils are generally composed of a silty or clayey matrix with embedded sand and gravel. Because the clay-size fraction of these soils was derived from glacial action on larger particles and various types of rock, this fraction has no predominant clay mineralogy. As a result of drainage basin soil properties, Buffalo River sediment tends to be relatively

fine and also contains a large fraction of silt (Raggio, Jirka, and Pacenka 1988).

The Buffalo River has been a recipient of pollution since the rise of the city in the early 19th century. The river's history is reflected in its sediment. For the industries along the Buffalo River, the river was not only a transportation link between suppliers and markets, but was also a source of necessary fresh water, as well as a receiver of industrial waste by-products. Portions of the Buffalo River sediment have been contaminated by these industrial discharges, as well as municipal and agricultural discharges and waste disposal. Contamination sources have decreased over the years; however, runoff from upland areas such as hazardous waste disposal sites and agricultural land, contaminated groundwater inflow, and accidental spills continue to pose a risk for additional sediment contamination (NYDEC and BRCC 1989).

The International Joint Commission (IJC) is a binational commission advising governments on issues involving the boundary waters between Canada and the United States. Since 1973, the IJC's Water Quality Board has identified 43 Areas of Concern (AOC's) on the Great Lakes where the poor water quality impairs use or local environmental standards are not being met. A portion of the Buffalo River has been identified as one of these 43 AOC's. The Buffalo River AOC extends from the mouth of the Buffalo River to the farthest point upstream at which backwater conditions exist during Lake Erie's highest monthly average lake level (USAED, Buffalo 1992a; NYDEC and BRCC 1989). Remedial Action Plans (RAP's) are being developed for all 43 AOC's. The Buffalo River's RAP (NYDEC and BRCC 1989) was completed in 1989.

Although the extent of sediment contamination remains in question, samples have been collected (using a variety of sampling and analytical techniques) by the U.S. Environmental Protection Agency (USEPA) Region V (17 stations) in 1981 and 1990; USAED, Buffalo (4 stations) in 1981; NYDEC (10 stations) in 1983; and Erie County, NY (58 stations over a 0.3-mile reach) in 1985. Analysis of these samples indicated that portions of the river's sediment contain moderate levels of metals, polychlorinated biphenyls (PCB's), polynuclear aromatic hydrocarbons (PAH's), DDT and metabolites, chlordane, and cyanides. Results of USEPA's 1990 sediment sampling and analysis program indicated that five areas of the Buffalo River (Dry Dock Cove, Dead Man's Creek, Hamburg Street, Blue Tower Turning Basin, and Mobil Oil Refinery) contained elevated levels of contamination. Contaminant levels are frequently higher in the Buffalo River AOC than in nearshore areas of Lake Erie and upstream Buffalo River control areas; however, the difference in median values is generally about one order of magnitude or less. Sediment data also indicated that arsenic, barium, copper, iron, lead, manganese, zinc, and cyanide exceed open lake disposal criteria (NYDEC and BRCC 1989; USAED, Buffalo 1992a). The Buffalo District (1992a) also indicated that, while portions of the Buffalo River sediment are contaminated, they are not considered toxic or hazardous and are not regulated under the Toxic Substances Control Act or Resource Conservation and Recovery Act.

Concerns over sediment contamination focus on impacts to the aquatic ecosystem and the potential for contaminated sediments to erode and wash into the Niagara River, a drinking water source for nearly a million people. A detailed inventory of the contaminated areas in the river and a sediment transport model were developed under the USEPA's Assessment and Remediation of Contaminated Sediments (ARCS) Program.

A comparison of contaminant levels in bottom sediments along the streambanks to those along the stream center line indicated the need to evaluate the potential for the addition of contaminated sediments to the Buffalo River from lower river streambank erosion (NYDEC 1989). However, considering that the Federal waters have been maintained for over 100 years, it is speculated that most of the sediment contamination in the river exists outside the Federal channel where it has not been removed by routine dredging.

Existing remediation alternatives for the contaminated portions of the Buffalo River include removing the contaminated sediment through dredging, leaving the contaminated sediments in place with armoring or capping layers, or a combination of dredging and capping. Sediment removal would involve dredging, transporting, and disposing the sediment or, depending on the level of contamination, dredging, transporting, treating, and disposing of the sediment. In-place capping would involve placing a layer of material (natural or synthetic) over the contaminated sediments and possibly modifying maintenance dredging depths. The capping layer would be of sufficient design (thickness, strength, etc.) to ensure that the contaminated sediment layer remains isolated from the surrounding sediment and water layers and the river's ecosystem (Raggio, Jirka, and Pacenka 1988; NYDEC and BRCC 1989).

Efforts to evaluate the effectiveness and potential impacts of remediation alternatives involving sediment removal indicated the need for a field demonstration project. This project is outlined in the chapters of the report that follow.

Additional information and project data are contained in the appendices that follow the main text. Appendix A consists of physical and chemical raw data for pre-dredged sediment and Appendix B contains summary statistics for pre-dredged sediment. Appendix C tabulates the locations of dredging and water quality monitoring stations. Appendix D summarizes background total suspended solids (TSS) statistics, while Appendix E contains TSS data and Appendix F summarizes statistics for TSS above background. Information on water column chemistry is presented in Appendices G-J. Appendix K contains summary statistics for post-dredged sediment and Appendix L is a side-scan sonar interpretation for the Buffalo River dredging demonstration. Appendix M provides information on the clarification supernatant from dredged material transportation barges and Appendix N contains data on *Daphnia magna*.

2 Dredging Demonstration

Background

The Water Resources Development Act of 1990 (WRDA) authorized the U.S. Army Corps of Engineers to remove sediments outside the limits of navigation channels for remediation purposes; however, WRDA required significant local cost-sharing. The Energy and Water Development Appropriations Bill of 1992 provided direct funding to the Buffalo District to demonstrate the capabilities and limitations of various dredging technologies (equipment designs and operations) at removing contaminated sediment from the Buffalo River navigation channel with minimal impacts to the ecosystem. In response to both pieces of legislation, the Buffalo River dredging demonstration removed sediment from within the navigation channel and along channel side slopes (USAED, Buffalo 1992a).

The objectives of the Buffalo River dredging demonstration were to determine and evaluate:

a. Open and closed clamshell bucket- and submersible pump-induced sediment resuspension.

b. Open and closed clamshell bucket- and submersible pump-induced contaminant releases to the water column.

c. The cleanup effectiveness of the open and closed clamshell buckets and the submersible pump.

d. The stability and containment effectiveness of a sediment dispersion barrier.

e. The applicability of mining flocculation technology to the clarification of transportation barge supernatant water.

This report summarizes the results of the Buffalo River dredging demonstration project as they apply to these five objectives. In order to evaluate the results of this project, the data were compared with previous environmental

dredging field studies and laboratory predictive techniques, where possible. The results of the demonstration project and these comparisons were used to make conclusions as to the effectiveness of the demonstrated dredging technologies at removing contaminated Buffalo River sediment with minimal impact to the ecosystem.

Great Lakes Dredge and Dock (GLDD), under contract with the Buffalo District, began removing sediment from the Buffalo River on 27 July 1992 and completed the demonstration dredging on 8 August 1992. The dredging technologies evaluated by this pilot level project included an open clamshell bucket, closed clamshell bucket, and submersible pump (Figures 4-6). A sediment dispersion barrier (Figure 7) and transportation barge supernatant flocculation technologies were also evaluated. The buckets, pump, and barrier were provided by GLDD under a lease contract with the Buffalo District, and the flocculent system was provided by the U.S. Bureau of Mines (USBM). The demonstration dredging was part of a larger fixed-price contract that covered maintenance dredging of the Federal navigation channel (USAED, Buffalo 1992a and 1992c).

Demonstration Sites

Demonstration site selection along the Buffalo River was for the most part controlled by the contaminant levels in the sediment. The Dry Dock Cove, Dead Man's Creek, Hamburg Street, Blue Tower Turning Basin, and Mobil Oil Refinery areas of the Buffalo River are among the sites along the Buffalo River (see Figure 3) and tributaries considered to contain elevated levels of contaminants. An additional investigation of these sites was performed in August 1991 by the USEPA's Large Lakes Research Station of Grosse Ile, MI, in order to determine the most appropriate demonstration sites. An interagency working group reviewed the data and recommended that the Dead Man's Creek site and the Mobil Oil site be selected for the dredging demonstration.

Facing downstream, the Dead Man's Creek upstream site is located on the right slope of the Federal channel. This site is located just downstream and around the river bend from the Ohio Street Bridge and upstream of Dead Man's Creek. The shoreline is protected by riprap and decaying bulkheads. The upstream Dead Man's Creek site runs from baseline Station 563+00 to 560+75 and is approximately 225 ft long by 80 ft wide.

Facing downstream, the Dead Man's Creek downstream site is also located on the right slope of the Federal channel. This site is located just downstream of Great Lakes Paper and just upstream of Dead Man's Creek. Dead Man's Creek was constructed in the mid-19th century to connect the Buffalo River with the Ohio Basin; however, by the mid-20th century, the creek and basin were filled with sediment. As a result, flow from the creek is limited to combined sewer overflow. The river shoreline at the downstream site is

protected by riprap and a decaying wooden bulkhead. The downstream Dead Man's Creek site runs from baseline Station 555+00 to 552+00 and is approximately 300 ft long by 80 ft wide.

Facing downstream, the Mobil Oil Refinery site is located on the left slope of the Federal channel. This site is located just downstream of the Conrail Corporation Bridge, across from the Mobil Oil refinery, and adjacent to an abandoned parking lot. Portions of the shoreline at this site are protected by a failing concrete bulkhead wall and portions are unprotected. This site runs from baseline Station 785+00 to 775+00 and is approximately 1,000 ft long by 80 ft wide.

Materials and Methods

Sediment characterization--pre-dredging

The USEPA collected sediment cores using its sampling vessel *The Mudpuppy* and a vibracore sampler. The cores were split, photographed, characterized, and sampled in the field. The samples were analyzed, and the results of the analyses were used to map the horizontal and vertical distribution of contaminants. The results of this evaluation were used to select three demonstration sites - Dead Man's Creek (upstream and downstream sites) and Mobil Oil Refinery (Figure 3). In order to meet the objectives of the demonstration project, sediment and water samples were collected at both these sites immediately prior to, during, and after the project (USAED, Buffalo 1992a).

The USEPA collected 12 sediment cores on the slopes of the Federal Channel at the Dead Man's Creek and Mobil Oil Refinery sites between 27 and 29 June 1992. These cores were used to identify the pre-dredge sediment conditions at the demonstration sites. The cores were collected using a Rossfelder model P-4 vibracore sampler (with 3.75-in. butyrate and/or 4-in.-diam, 6-mil polyethylene core liners and 4-in. stainless steel core noses) mounted on *The Mudpuppy*. Core locations were verified with an onboard global positioning system. Six cores were collected in the downstream portion of the Dead Man's Creek site (Figure 8) and two cores were collected in the upstream portion of the Dead Man's Creek site (Figure 9). Four cores were collected at the Mobil Oil Refinery site (Figure 10). The vibracore sampler was allowed to penetrate the sediment until "refusal" and resulted in core lengths ranging from 1.5 to 8.3 ft (USEPA 1992). Data for these samples are included in Appendix A.

Upon retrieval, the sediment cores were split and placed in 250-ml high density polyethylene (HDPE) containers for onsite analysis of total PCB and total PAH by the USEPA; 1-ℓ glass containers for percent total solids, pH, total organic carbon (TOC), PCB, PAH, and metals determination by Applied Research and Development Laboratory, Inc. (ARDL) of Mount Vernon, IL; and 5-gal HDPE containers for grain size distribution, Unified Soil

Classification System (USCS) classification, and Atterberg limits determination by Holcomb Foundation Company of Carbondale, IL. The samples were kept on ice until analyzed. Total PAH was determined onsite by fluorometric analysis. Total PCB was determined onsite using the Envirogard PCB Enzyme Immunoassay Test Kit (USEPA 1992).

Sediment characterization--post-dredging

Post-dredging sediment conditions were determined by collecting grab samples at the demonstration dredging sites following the sediment removal. The grab samples were collected using a hand-operated Ponar sediment sampler. Sample locations were near the center of the dredged area width and at approximately equal intervals along the length (upstream to downstream) of the dredged areas. Five composite samples (three grab samples per composite) were collected from the U.S. Army Engineer Waterways Experiment Station's sample boat *Mr. Dave* at the downstream Dead Man's Creek site by WES and Buffalo District personnel on 31 July 1992 (Figure 11). Eleven composite samples were collected from the *Mr. Dave* at the Mobil Oil Refinery site by WES and Buffalo District personnel on 8 August 1992 (Figure 12). Five composite samples were collected off the starboard side of the dredge barge at the upstream Dead Man's Creek site by WES and Buffalo District personnel on 8 August 1992 (Figure 13).

Upon retrieval, the grab samples were either composited or placed directly into 0.5-ℓ glass containers for percent total solids, pH, TOC, and PAH determination and 0.5-ℓ plastic containers for metals determination by ARDL. The glass containers were kept on ice or refrigerated until the sediment was analyzed. Methods used in analyzing the sediment samples are listed in Table 1.

Channel topography

Depths. As part of the maintenance of the Buffalo River Channel, the Buffalo District gathered sounding data at the three demonstration sites. Although not extending all the way to the shoreline, pre- and post-dredging soundings (adjusted to low-water datum) at the two Dead Man's Creek sites and the single Mobil Oil Refinery site were collected in July 1991 and April, May, and August 1992. The April and May 1992 soundings were considered to represent pre-dredging water depths and the August 1992 soundings were considered to represent post-dredging water depths. However, since maintenance dredging around the Mobil Oil demonstration site began immediately following the demonstration project (8 August 1992), the post-dredging soundings may have been affected by the maintenance dredging.

The pre- and post-dredge river bottom profiles at three dredging areas were also surveyed by Buffalo State College (BSC) personnel using a Klein dual-frequency (100 and 500 kHz) portable side-scan sonar. These data were

collected prior to and after the dredging demonstration. Results of this assessment are presented in Appendix L.

Water column monitoring

Water quality samples were collected at 19 sampling stations located upstream and downstream of the dredge by Buffalo District, WES, and BSC personnel over the 11-day demonstration period. Water samples from all 19 stations were analyzed for total suspended solids (TSS). Water samples from Stations 1, 11, 13 through 15, and 16 through 18 were analyzed for total and dissolved metal, nitrogen ammonia, total organic carbon, PCB, and PAH. The upstream and downstream location of the 19 stations varied by site and dredge equipment. Approximate sample locations are provided in Figures 14 through 16. Daily station locations are provided in Appendix C.

A typical sample period lasted approximately 1 to 3 hr and was performed by the Buffalo District and WES personnel on the dredge barge, one WES sampling crew on the *Mr. Dave*, and two BSC sampling crews and boats. Samples were generally collected at each station by first measuring the water depth and determining the 10-, 45-, 75-, and 90-percent water sample depths at Stations 0 through 12 and the 3-ft and 75- and 90-percent depths at Stations 13 through 18. Once the sample depths were determined and several hose volumes of river water at the sample depth had flowed through the intake hose, the water sample was pumped into labeled plastic (for TSS, metals, and nitrogen ammonia analysis) or glass (for PAH, PCB, and TOC analysis) containers. At the end of a sample period (the time it took for each crew to sample their respective stations), the samples were delivered to an onsite mobile unit, provided and manned by the analytical laboratory (ARDL), to catalogue (for analysis and chain-of-custody) and split the samples. Analytical methods used by ARDL for water samples are listed in Table 1. A total of 38 sampling periods, lasting between 1 and 3 hr, were completed over the 11 days of monitoring.

The majority of the Station 0 and Station 3 TSS water samples were collected by Buffalo District and WES personnel using centrifugal pumps with rubber and metal impellers and rubber intake hoses. For the open bucket (with and without dispersion barrier) and closed bucket monitoring days, the Station 0 pump was connected to a manifold system that was in turn connected to four hoses running from the stern to the bow of the dredge barge and into the water at the four sampling depths. For the submersible pump monitoring days, the manifold was connected to six hoses that ran to six sampling ports on a sampling array that was fixed to the pump (Figure 6). For all dredges, the Station 3 pump was connected to one hose that was raised and lowered to the proper sampling depths. All Station 0 and 3 water samples intended for chemical analyses (total and dissolved metal, nitrogen ammonia, TOC, PCB, and PAH) were collected by the *Mr. Dave* and crew using a peristaltic pump with teflon hoses.

With the exception of Stations 4, 5, and 6 at the downstream Dead Man's Creek site (open bucket with dispersion barrier), TSS water sample stations near the dredge (Stations 0 through 6) at all three sites were sampled by the *Mr. Dave* crew using a peristaltic pump and teflon tubing. Water samples to be analyzed for total and dissolved metal, nitrogen ammonia, TOC, PCB, and PAH were collected at Station 1. The WES crew also measured the dissolved oxygen, temperature, and pH of the water at the four sampling depths at Station 1 using appropriate meters. In addition, an acoustic doppler device was used to measure turbidity and water velocity at the cross sections of Stations 1 and 2, 7 through 9, and 10 through 12.

Water sample stations upstream and downstream of the dredge (Stations 7 through 18) at all three sites were sampled by the BSC boats and crew using peristaltic pumps and teflon tubing. Water samples to be analyzed for total and dissolved metal, nitrogen ammonia, TOC, PCB, and PAH were collected at Stations 11, 13 through 15, and 16 through 18. One of the BSC crews also monitored water velocity, pressure, temperature, conductivity, pH, percent light transmission, irradiance, fluorescence, and dissolved oxygen at Stations 11, 13 through 15, and 16 through 18 (Appendix I). Data from the farthest upstream (13-15) and downstream (16-18) stations were collected at the beginning of each day prior to dredging (morning) and after dredging was completed for the day (afternoon).

Low-level organic analyses. Ten water samples were collected from Stations 16-18 below the dredging sites for low-level PCB and PAH analyses, i.e., less than 1 ng/ℓ. The low-level analytical work was performed by Buffalo State College. Two of these samples were collected on 24 July prior to the start of dredging, and a third sample was a field duplicate. The procedures required the collection of a 60-ℓ composite sample. This sample was filtered through a Whatman glass fiber filter (GF/F) to remove suspended solids. Solids collected on the filter and the filtrate were analyzed separately for total PCBs and for the PAHs benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.

Deadman's Creek--downstream

The downstream Dead Man's Creek site was the first site dredged. The open clamshell bucket surrounded by a sediment dispersion barrier was monitored from 27 to 29 July 1992. Approximate locations of the water quality monitoring stations are summarized in Appendix C. For this site, Stations 13-15, 7-9, 10-12, and 16-18 were held constant as the dredge advanced; Stations 0-6 were located relative to the dredge (for each sample period or daily). Proceeding downstream, Stations 13 through 15 were located approximately 3,130 to 3,350 ft upstream from the dredge bow; Stations 7 through 9 were 330 to 550 ft; Station 3 was 90 ft; Stations 2 and 4 were 10 to 120 ft; Station 0 was at the dredge bow; Station 1 was 30 to 170 ft downstream; Stations 5 and 6 were 130 to 320 ft downstream; Stations 10 through 12 were

390 to 610 ft downstream; and Stations 16 through 18 were 2,050 to 2,270 ft downstream.

Mobil Oil site

The Mobil Oil Refinery site was the second site dredged. The open and closed clamshell buckets and submersible pump were all monitored from 30 July to 7 August 1992. The approximate water quality monitoring station locations are summarized in Appendix C. For this site, Stations 13-15 and 16-18 were held constant as the dredge advanced; Stations 0-12 were located relative to the dredge (for each sample period or daily). For the open clamshell bucket and proceeding downstream, Stations 13 through 15 were located approximately 1,610 to 1,680 ft from the dredge bow along the channel's baseline; Stations 7 through 9 were 110 to 180 ft upstream of the dredge bow; Station 0 was at the dredge bow; Station 4 was an estimated 150 ft; Station 3 was 90 ft; Stations 1 and 2 were 130 to 190 ft; Stations 5 and 6 were an estimated 300 ft; Stations 10 through 12 were 510 to 570 ft; and Stations 16 through 18 were 930 to 990 ft. For the closed clamshell bucket and proceeding downstream, Stations 13 through 15 were located approximately 1,250 to 1,590 ft from the dredge bow along the channel's baseline; Stations 7 through 9 were 50 to 180 ft; Station 0 was at the dredge bow; Station 4 was an estimated 150 ft; Station 3 was 90 ft; Stations 1 and 2 were 150 to 220 ft; Stations 5 and 6 were 220 to 450 ft; Stations 10 through 12 were 420 to 750 ft; and Stations 16 through 18 were 1,010 to 1,350 ft. For the submersible pump and proceeding downstream, Stations 13 through 15 were located approximately 1,070 to 1,220 ft upstream from the dredge bow; Stations 7 through 9 were 70 to 220 ft upstream; Station 0 was on the pump; Station 4 was an estimated 150 ft; Station 3 was 90 ft; Stations 1 and 2 were 70 to 180 ft; Stations 5 and 6 were 280 to 430 ft; Stations 10 through 12 were 580 to 730 ft; and Stations 16 through 18 were 1,380 to 1,530 ft.

Deadman's Creek--upstream

The upstream Dead Man's Creek site was the third and final site dredged. The submersible pump was monitored on 8 August 1992. Approximate water quality monitoring station locations are provided in Appendix C. For this site, Stations 13-15, 5-9, 10-12, and 16-18 were held constant as the dredge advanced; Stations 0-4 were located relative to the dredge (for each sample period). Proceeding downstream, Stations 13 through 15 were located approximately 2,340 to 2,470 ft upstream of the dredge bow; Stations 7 through 9 were 640 to 770 ft upstream; Station 3 was 90 ft; Stations 2 and 4 were 100 and 200 ft west of the dredge; Station 0 was on the pump; Station 1 was an estimated 50 ft; Stations 5 and 6 were 130 to 270 ft; Stations 10 through 12 were 730 to 870 ft; and Stations 16 through 18 were 2,930 to 3,070 ft.

Data analysis

Assuming normal distribution, summary statistics (sample size, mean, minimum and maximum value, standard deviation, and variance) of the pre- and post-dredged sediment data at the three demonstration sites were determined. To be consistent with NYDEC water quality data analysis, all values below detection (indicated by U or < in the appendices) were assumed to be zero. The standard error or standard mean error provided in these tables signifies the reliability of the mean and was calculated by dividing the standard deviation of the data by the square root of the sample size (Miller, Freund, and Johnson 1990). The standard mean error is used in this report to indicate the range that a particular data point can fall. The ARDL-estimated (indicated by J) and range-exceeded (indicated by E) organic data concentrations were assumed to be equal to the indicated value for statistical analysis.

Statistics pertaining to the physical and chemical conditions of the pre-dredging sediment cores and post-dredging sediment grab samples, as they pertain to each dredge, are summarized in the following chapters.

An examination of the background TSS (Stations 13-15), velocity, and rainfall data indicated that background TSS concentrations could be determined by grouping these data by site (Dead Man's Creek and Mobil Oil Refinery) and water velocity (<0.4 fps, >0.4 fps≤ 1.5 fps, and >1.5 fps). Once separated, summary statistics (sample size, mean, minimum and maximum value, standard deviation, and variance) were calculated (using Statpro Version 2.0 software) for each sample period, station, and depth within the group. The normality of these data groups was checked using Statpro's Q-Q plot function. If normally distributed, the variances (two-sample F-test) and means (two-sample t-test or Smith-Satterthwaite test) of the data (grouped by site, velocity, and sample period) were compared both cross-sectionally and depth-wise to determine if there was a statistically significant difference between the background TSS data using a 0.01 level of significance. If there was no significant difference, the background data for each sample period in the group were averaged both cross-sectionally and depth-wise. If there was a significant difference either cross-sectionally or depth-wise, the data were averaged accordingly. If there was a significant difference both cross-sectionally and depth-wise, the data were not averaged (Miller, Freund, and Johnson 1990).

Recalling that the background Stations 13-15 were only sampled as part of the morning and afternoon sampling periods, this left the periods between without background data. Thus, the background concentrations for these sample periods were estimated by using the morning and afternoon background data, velocity data, and TSS concentrations at Stations 7 through 9. These estimates reflected the cross-sectional and depth-wise variations experienced with the morning and afternoon background data.

Once background TSS concentrations were determined for each sample period, these data were subtracted from the downstream water quality sample

stations (0-12 and 16-18) to give the TSS concentration above background or the dredge-induced TSS concentration. Once reduced, the downstream, dredge-induced data were separated by dredge type and operation. Similar to the background data and where applicable, these data were evaluated to determine cross-sectional and/or depth-wise variation. These data were averaged accordingly and reported as the mean dredge-induced TSS concentration (Appendix E).

Available funding and the high cost of chemical analyses limited the amount of chemical water quality data collected. However, these data for the overall project were compared with NYDEC water quality criteria for D through A class water bodies (Appendix H).

The complete water quality sample station number, sample and total water depth, TSS and chemical concentration, and velocity data sets are provided in Appendices E, G, and I. Data for each sampling day are divided by double lines and headings. Data for the daily sample periods are divided by single lines. The station numbers in each sample period are organized moving from the upstream stations (13-15 or 7-9) to the downstream stations (16-18 or 10-12).

Weather

The *Buffalo News'* weather summary of 8 August 1992 (compiled by the National Weather Service) indicated that July of 1992 was the wettest July on record in over 120 years of record-keeping, with 8.93 in. of precipitation falling in the Buffalo, NY, area (2.96 in. is normal).

The *Buffalo News'* (12 September 1992) August weather summary indicated that the 3.79 in. of precipitation that fell in the Buffalo area during that month was below the normal of 4.16 in. The "character of the day" and precipitation for the dredging demonstration days are provided in Table 2. Velocity data collected by the sampling crews are summarized, along with the TSS data, in Appendices C and I.

The large amount of precipitation in the Buffalo River watershed resulted in high river flow velocities during the sampling periods, and the river frequently contained a significant amount of suspended sediment, as well as debris (i.e., logs, trash, etc.). These conditions also lead to variable background TSS readings, higher sediment load capacity, and greater dispersed sediment transport distances.

3 Open Clamshell Bucket

The cable-controlled, open clamshell bucket surrounded by the sediment dispersion barrier was used to remove sediment from the downstream Dead Man's Creek site between baseline Stations 552+00 and 555+00 on 27 through 29 July 1992. The same bucket (less the dispersion barrier) was used to remove sediment from the Mobil Oil Refinery site between baseline Stations 775+00 and 775+70 on 30 and 31 July 1992.

Since the open clamshell bucket was surrounded by the dispersion barrier at the downstream Dead Man's Creek site, bucket-induced sediment resuspension and transport were affected by the barrier. Therefore, the resuspension generated by the open bucket at this site was used to measure the effectiveness of the barrier (see Chapter 7). The pre- and post-dredging sediment conditions at both the downstream Dead Man's Creek and Mobil Oil Refinery sites will also be discussed in this part of the report. However, the evaluation of the contaminated sediment removal efficiency of the dredges for this project cannot be fully evaluated, since the Corps' dredging authority for the project placed physical restraints on the depth and width of cut.

Bucket Design and Operation

The open clamshell bucket used in this project was a Blaw-Know 3-cu-yd capacity, 5-cable-operated (2 hoist, 2 closing, and 1 tagline cables), lever arm, riveted bucket. The bucket had a grab width of 10.9 ft and was 3.4 ft high by 4.8 ft wide. The bucket's empty weight was 1,500 lb. The bucket cables were routed through a cable-operated lattice boom (two sections) that was mounted on a diesel-operated upper structure containing the cable drums, power unit, and operator's cab. The upper structure was mounted on a tracked undercarriage that was fixed to the dredge barge with cables. The boom, upper structure, and undercarriage were manufactured by Lima Cranes (model number 1250; GLDD crane 16) and, as a unit, had a rated capacity of 100 tons.[1]

[1] Personal Communication, John T. O'brien, Great Lakes Dredge and Dock, Cleveland, OH.

Crane 16 was mounted on the deck of a 426-gross-ton derrick barge. The barge measured 121 ft × 44 ft × 9 ft. Barge structural and mechanical integrity was American Bureau of Shipping rated for lake work. The barge's position was maintained by two stern-mounted spuds. This barge had a light draft of 2.25 ft and a loaded bow draft of 4 ft.[1]

To obtain a payload, the crane's upper structure rotated off the bow of the dredge barge, approximately between the center line of the barge and 45 to 90 deg starboard of the center line, with a fixed boom angle. This operation resulted in an arc-shaped cut or removal arc. At the completion of an arc, the boom angle was adjusted to cut the next arc. Once the boom angle was increased to the limits of safe operation and crane capacity, the dredge barge spuds were lifted and the tug *Mackie* propelled the integrated tug-transportation barge-dredge barge vessel forward. The dredge advanced in the downstream direction at Dead Man's Creek and upstream at Mobil Oil Refinery. Details of the dredge operation are provided in Tables C1 through C4.

Bucket payloads were obtained by lowering the fully opened bucket to the sediment layer. Once at the sediment layer, the hoisting wires were kept slack to allow the bucket to penetrate into the sediment by its own weight. Once penetration ceased and with the hoisting wire slack, the closing wires were hauled in and the bucket closed around the disturbed sediment, leaving behind a semicircular shaped cut or crater in the sediment layer. Once the bucket was closed, the hoisting wires were retrieved, causing the loaded bucket to move upward through and out of the water column. As hoisting continued upward through the air, the upper structure rotated the excavating attachments (boom and bucket) over the transportation barge's (GLDD barges 230, 232, 59, or 60) cargo hole. Once over the hole and using the hoisting wires, the bucket was lowered in and the closing wires were released. Once the closing wires were released, the bucket jaws opened and the bucket's payload was released. With the closing wires slack and the bucket opened, the bucket was returned to the sediment layer to retrieve another load. The time it took to accomplish this sequence is referred to as the bucket's working cycle time.

The bucket cycle time was monitored while the dredge operated. The open clamshell bucket was operated at a 3-min cycle time on 30 July 1992 (days 5/1-5/4)[2] and a 2-min cycle time on 31 July 1992 (days 6/1 and 6/2). For the given site conditions and equipment design, a 3-min cycle was representative of a slow operation. A 2-min cycle (possibly even 1 min) was representative of a normal operation. A cycle time of 1 min equates to a maximum production rate, i.e., bucket payload at capacity, of 180 cu yd/hr.

Less than optimum payloads were obtained when the bucket encountered sediment that was not consistent with the bucket design and operation. One

[1] Personal Communication, John T. O'brien, Great Lakes Dredge and Dock, Cleveland, OH.

[2] This notation is used to indicate the project day number and the sample period number. Date and time corresponding to day and period are shown in Tables C12 to C16.

type of unsuccessful cycle occurred when working in relatively soft sediment. The bucket penetrated too deeply into the sediment layer and, when closed, lifted a heaping payload. This operation tended to increase production but spillage likely increased releases during movement through the water and air columns. Another type of unsuccessful cycle occurred when large pieces of sediment debris (i.e., timber) became trapped between the bucket jaws upon closure. This caused sediment to leak out from between the jaw during movement through the water and air columns and also likely contributed to increased releases. Although unsuccessful cycles occurred regularly, they were the exception rather than the rule during this project. However, the frequency of these cycles could have been reduced by changing buckets (size and weight) as the sediment conditions varied; carefully controlling bucket penetration using the hoisting wires; cleaning up sediment debris with a grapple bucket prior to operating the clamshell buckets; and utilizing better equipment instrumentation.

As mentioned earlier, bucket payloads were placed in GLDD transportation barge Nos. 230, 232, 59, and 60. Barge 230 had edge-of-deck dimensions of 260 × 52 × 17 ft. Barge 232 had dimensions of 207 × 36 × 17 ft with a 2-ft coaming. Barges 59 and 60 were formerly door-operated bottom dump hopper barges with seven cargo pockets; however, these barges were fabricated into tank barges by welding the doors shut. The transportation barges were fixed to the dredge barge (sterns in alignment) with cables. Once filled or at the end of a dredging day, the transportation barges were hauled to a confined disposal facility by GLDD's tugboat *Mackie*. Barge overflow of supernatant, a common production practice, was not allowed during this environmental dredging demonstration.

Other potential suspended sediment releases were noted during the demonstration. Although sometimes working in velocities above 1 fps, the tugboat's propwash generated visible sediment plumes when operating near the slopes of the river. This same effect was noted for ships travelling up and down the river. Also, in order to clean the decks of the transportation barges prior to hauling, the crane operator filled the bucket with river water and dropped it on the barge's deck. However, during this project, the most important effect on TSS concentrations was the contribution from the watershed during runoff from storm events.

Pre-Dredging Sediment Characteristics

A description of the downstream Dead Man's Creek (B/L Stations 552+00 to 555+00) and Mobil Oil Refinery site (B/L Stations 775+00 to 785+00) pre-dredging sediment sampling core locations, sampling techniques and personnel, sample preservation and analysis, and statistical analysis was provided in Chapter 2 of this report. This section discusses the summary statistics of the physical and chemical properties of the pre-dredging sediment cores as they pertain to the open clamshell bucket operation.

Although three separate pieces of equipment were operated at the Mobil Oil Refinery site, the summary statistics of the sediment cores taken at this site were grouped together. This was done because the sediment cores were not evenly distributed throughout the site, there was no clear trend to the data, there were no cores taken in the portion of the site that the open clamshell bucket operated, and there was only one core taken in the portion of the site that the submersible pump operated.

Physical properties

Grain size distribution ranges of the downstream Dead Man's Creek and Mobil Oil Refinery site sediment cores are provided in Figures 17, 18, and 19. Atterberg limits, USCS classification, and total solids concentrations for the various core intervals at these sites are provided in Appendix A. Summary statistics for the Atterberg limits and percent solids are provided in Appendix B.

All of the sediment core particles fell in the silt and clay-size range. Based on the grain size distribution and Atterberg limit data, all but four (two lean clays (CL's) and two silty clays (CL-ML's)) of the Dead Man's Creek sediment core intervals had a USCS classification of ML (silt with a low liquid limit). This classification can represent inorganic silts, very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity. All but one (CL) of the Mobil Oil sediment core intervals had a similar USCS classification of ML.

The downstream Dead Man's Creek sediment has a relatively low mean liquid limit of 37.5 percent and a mean plastic limit of 26.8 percent. The Mobil Oil Refinery sediment also had a relatively low mean liquid limit of 41.1 percent and a mean plastic limit of 32.5 percent. The standard mean error of the liquid and plastic limits of the Dead Man's Creek and Mobil Oil sediment were 1.9 and 1.7 and 1.3 and 1.8, respectively (Appendix B).

The downstream Dead Man's Creek sediment has a mean percent total solids of 66.3 percent and the Mobil Oil Refinery sediment had a mean percent total solids of 62.0 percent. Standard mean errors of these data were 1.7 and 2.3, respectively (Appendix B). The percent total solids data equated to a mean water content of 51 percent for the downstream Dead Man's Creek site and 61 percent for the Mobil Oil Refinery site. Since both mean site water contents were greater (although only slightly) than the liquid limits of the sediment (37.5 and 41.1 percent), the sediment at both sites was expected to behave as a highly viscous liquid. Therefore, neither of the site sediments would likely exhibit a great deal of resistance to penetration by the opened clamshell bucket. By the same token, the water content was not likely great enough to cause the material to flow away from the bucket upon impact with the sediment.

Chemical properties

Raw data and summary statistics of the chemical conditions at the downstream Dead Man's Creek and Mobil Oil Refinery sites are provided in Appendices A and B.

The downstream Dead Man's Creek sediment cores had a mean pH of 7.4 and the Mobil Oil Refinery sediment cores had a mean pH of 7.5. These data indicate that the sediment cores were slightly alkaline or basic. The standard mean error for both data sets was 0.1.

The downstream Dead Man's Creek sediment cores had a mean TOC of 21,000 mg/kg and the Mobil Oil Refinery sediment cores had a mean TOC of 24,300 mg/kg. These are representative of typical sediment TOC concentrations.

The downstream Dead Man's Creek and the Mobil Oil Refinery sediment core interval concentrations of PCB Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260 were below ARDL's detection limit. Although determined using an experimental analytical technique, USEPA (1992) indicated a mean total PCB (all Aroclors) concentration of 8.4 mg/kg at the downstream Dead Man's Creek site and 3.6 mg/kg at the Mobil Oil Refinery site (Appendix A). Based on comparisons with sample standards, USEPA (1992) also cautioned that the total PCB data were biased to the high side. The detected concentrations are considerably higher than those historically found in Buffalo River sediments. Selected core samples were analyzed by the WES Environmental Chemistry Branch using USEPA approved analytical techniques. These data show total PCB concentrations in the range from <0.026 to 1.2 mg/kg, with a median concentration of 0.27 mg/kg for seven samples.

The PAH compounds were also thought to be present in moderate concentrations. However, with the exception of mean phenanthrene (2.5 mg/kg), fluoranthene (1.5 mg/kg), pyrene (1.6 mg/kg), and benzo (a) anthracene (0.63 mg/kg), all means of the downstream Dead Man's Creek PAH compounds in the sediment cores were found at concentrations less than 1 mg/kg. The Mobil Oil Refinery sediment core means had even lower PAH concentrations than the downstream Dead Man's Creek sediment cores; with only phenanthrene (1.1 mg/kg) having a concentration greater than 1 mg/kg. Although determined using an experimental analytical technique, USEPA (1992) indicated a mean total PAH concentration of 410 mg/kg at the downstream Dead Man's Creek site and 240 mg/kg at the Mobil Oil Refinery site. Comparing the concentrations of the individual PAH compounds with the total PAH concentrations indicates a large difference in sediment PAH concentration at both sites.

Sediment core metal concentrations were also determined. Sample analyses and summary statistics are provided in Appendices A and B, respectively. Chromium, copper, lead, and zinc concentrations for the three dredging sites are compared in Table 3.

Site Water

Pre-dredging water depths

Using the April 1992 sounding data, pre-dredging water depths (referred to low water datum) in the Federal channel at the downstream Dead Man's Creek site (B/L Stations 552+00 to 555+00) ranged from approximately 20 to 22 ft. Water depths at the toe of the Federal channel slope ranged from approximately 14 to 22 ft.

Using the May 1992 sounding data, pre-dredging water depths (referred to low water datum) in the Federal channel at the Mobil Oil Refinery site (B/L Station 775+00 to 775+70 for this bucket) ranged from approximately 18 to 19 ft. Water depths at the toe of the Federal channel slope were approximately 18 ft.

Post-dredging water depths

Using the 27 August 1992 sounding data, post-dredging water depths (referred to low water datum) along the slope of the Federal channel at the downstream Dead Man's Creek site were up to 7 ft below grade. Post-dredging water depths along the slope of the Federal channel at the Mobil Oil Refinery site were up to 10 ft below grade. The final channel slope at both sites appeared greater than 1 on 3.

Since the Buffalo District's post-dredging sounding data were taken several weeks after the completion of the demonstration and maintenance dredging, it was assumed that the 27 August 1992 sounding data between the shoreline and 80 ft away from the shore (the toe of the Federal channel slope would fall 66 ft from the water's edge - 22 ft deep with 1 on 3 slope) represented the sediment removed by the demonstration project. Sediment outside this range was assumed to be removed by the maintenance dredging project.

The area between the designated pre- and post-dredging sounding data represented the sediment removed by the demonstration project. The volume of sediment removed for each dredge was calculated using the average end area method. These calculations indicated that approximately 3,900 cu yd of sediment was removed by the open clamshell bucket at the downstream Dead Man's Creek site. Approximately 700 cu yd of sediment was removed by the open clamshell bucket at the Mobil Oil Refinery site.

Background TSS

The opened clamshell bucket was operated at the Mobil Oil Refinery site with a 3-min cycle time on 30 July 1992 (day 5/1-5/4) and a 2-min cycle time on 31 July 1992 (days 5/1 and 5/2). Background TSS (Stations 13-15) data

were only collected on days 5/1 and 5/4 and 6/1. Days 5/1 and 6/1 experienced water velocities >0.4 fps and were grouped with similar Mobil Oil background data sets (days 7/1, 8/1 and 8/3, and 11/1) to determine an acceptable method for summarizing the data. Normality checks and F- and t-tests indicated that these data did not vary significantly (at a 0.01 level of significance) with cross section or depth. Therefore, the background TSS data for days 5/1 and 6/1 were averaged cross-sectionally and depthwise. The resulting mean background TSS concentrations for days 5/1 and 6/1 were 97.7 and 132.5 mg/ℓ with standard mean errors of 2.5 and 10.7 mg/ℓ, respectively.

Water velocities for sample period 5/4 were less than 0.4 fps. These data were grouped with data sets from days 9/1 and 9/3, 10/1, 12/1 and 12/3, and 13/1 and 13/5. Normality checks and F- and t-tests indicated that these data also did not vary significantly (at a 0.01 level of significance) with cross section or depth and were averaged accordingly. The resulting mean background TSS concentration for day 5/4 was 43.7 mg/ℓ with a standard mean error of 2.4 mg/ℓ.

An examination of the velocity data and TSS concentrations at Stations 7-9 indicated that a reasonable assumption for background TSS concentrations for days 5/2, 5/3, and 6/2 were 70, 60, and 155 mg/ℓ, respectively. Background TSS data summary statistics and assumed values for the open bucket are summarized in Appendix D.

An important factor for the monitoring program and evaluation of results was the high background TSS levels resulting from record rainfall during the period of the demonstration. Typical TSS concentrations in July at base flow are on the order of 10 mg/ℓ for the Buffalo River. The concentrations observed during the demonstration are much greater, making it difficult to assess the effects of the dredging activities. Perhaps more significant is the wide variation in background TSS, even on a daily basis. The unsteady conditions for sediment loading and background TSS and chemical data complicate data analyses and detract from potential advancements offered by the dredging demonstration.

Chemical

Chemical data are discussed in Chapter 6 of this report.

Dredging-Induced Sediment Dispersion

Previous findings

Bray (1979) indicated that in fluvial rivers (not influenced by tidal flows), sediment dispersion is generally caused by water flow in the downstream direction. This dispersion occurs in various forms: suspension, saltation,

rolling, and fluid mud. The lighter particles are carried in suspension (some permanently) and are sometimes referred to as sediment resuspension or turbidity. Larger particles tend to move in a jumping motion off the river bed and back on to it again; this is called saltation. The largest particles never leave the sediment layer but roll along the surface. Fluid mud marks the transition zone between turbid water and bottom sediment. This type of sediment dispersion occurs with a large amount of particle interaction. Near-field (within several hundred feet of the dredge) dredging-induced sediment dispersion can include all four forms of transport. However, far-field (outside of the first few hundred feet from the dredge) dredging-induced sediment dispersion generally includes only suspended transport. This type of dispersion generally refers to low concentrations of silt and clay-sized particles (with diameters <0.03 mm) or small flocs (i.e., masses of agglomerated particles) that settle independently through the water column at very slow rates.

Suspended sediment concentrations induced by dredging operations have been monitored previously. Results from Corps of Engineers' research programs are summarized in Table 4. Maximum suspended solids concentrations observed were 140 to 1300 mg/ℓ in the immediate vicinity of the dredge. These studies have been summarized by Herbich and Brahme (1991), McLellan et al. (1989), and Collins (1995).

Dredging-induced TSS

Mean background TSS concentrations were subtracted from TSS observations at Stations 0-12 and 16-18 to provide an estimate of the dredge-induced sediment dispersion. Once reduced, these data were grouped by dredge type and operation and statistically analyzed to determine the best method of summarizing them. Statistical non-variance with cross section and depth is an indication that the TSS data were either uniformly high (in a dredging-induced plume) or uniformly low (not impacted by the dredge). When the data varied with cross section, it is an indication that the plume is confined to a portion of the channel's cross section. When the data varied with depth but not cross section, it is an indication that the dredging-induced TSS was confined to the lower water column or had settled out to a given depth.

The opened clamshell bucket-induced TSS data corresponding to a 2-min cycle (days 6/1 and 6/2) were grouped together. Normality checks and F- and t-tests, at a 0.01 level of significance, indicated that Station 7-9 data varied with cross section but not depth; individually, Stations 0, 4, and 3 did not vary with depth; Stations 1 and 2, 10-12, and 16-18 did not vary with cross section or depth; and Stations 5 and 6 did not vary with cross section but did with depth. These data were averaged according to these analyses and the resulting summary statistics are provided in Appendix F.

The open clamshell bucket-induced TSS data corresponding to a 3-min cycle time (days 5/1-5/4) were also grouped together. Normality checks and

F- and t-tests at a 0.01 level of significance indicated that Stations 7-9, 1 and 2, 5 and 6, and 10-12 data did not vary cross-sectionally but did vary with depth; individually, Stations 0, 4, and 3 did not vary with depth; and Stations 16-18 did not vary with cross-section or depth. These data were averaged according to these analyses and the resulting summary statistics are provided in Appendix F.

The data in Appendix F show that the dredging-induced TSS concentrations range from zero for some stations to a high value of 66 mg/ℓ. This is in the range of previous studies. Another way of looking at the suspended solids concentrations resulting from dredging is to compare the mean concentrations at the river cross section immediately upstream of the dredge (Stations 7-9) to the concentrations at the cross section downstream of the dredge (Stations 10-12). Current was observed to be in the downstream direction; therefore, the plume from the dredge would be expected to move downstream. Results of this comparison for the open bucket dredge are shown in Figure 20. Asterisks over the bar indicate a statistically significant difference in mean concentrations (average of three stations × four depths). The largest increase is approximately 90 mg/ℓ. In a few cases the concentration decreased at the downstream cross section. This anomaly may be the result of particle settling between the cross sections, which was enhanced by the silt curtain due to slower velocities. The silt curtain fabric may also have filtered a portion of the river's suspended solids measured at the upstream stations. Figure 21 illustrates the effect of bucket cycle time on the increase in TSS. A general trend of lower TSS concentrations with longer cycle times was observed.

Post-Dredging Sediment Characteristics

A description of the Dead Man's Creek (B/L Stations 552+00 to 555+00) and the Mobil Oil Refinery site (B/L Stations 775+00 to 785+00) post-dredging sediment grab sample locations, sampling techniques and personnel, sample preservation and analysis, and statistical analysis was provided in Chapter 2 of this report. Summary statistics of the physical and chemical properties of the post-dredging sediment samples as they pertain to the open clamshell bucket operation are provided in Appendix K.

While both the open and closed clamshell buckets were operated at the Mobil Oil Refinery site, no sediment grab samples were collected in the small reach of open bucket operation (B/L Station 775+00 to 775+70). Therefore, the post-dredging sediment conditions for the open clamshell bucket at the Refinery site were inferred by examining the properties of the grab sample at baseline Station 776+00 (see Appendix K).

Chemical properties

The downstream Dead Man's Creek post-dredging grab sediment samples had a mean pH of 6.4 (slightly acidic) with a standard mean error of 0.1 and

mean TOC of 19,200 mg/kg with a standard mean error of 1,840 mg/kg. Like the pre-dredging sediment, all post-dredging PCB Aroclor concentrations were below detection. With the exception of phenanthrene (2.1 mg/kg), pyrene (3.5 mg/kg), and dibenzo (a,h) anthracene (1.4 mg/kg), all mean PAH compound sediment concentrations were less than 1 mg/kg. The standard mean errors of the phenanthrene, pyrene, and dibenzo (a,h) anthracene were 0.74, 0.94, and 0.74 mg/kg, respectively. Metal concentrations after dredging were generally the same order of magnitude as the sediment characterized by the pre-dredging sediment cores. This fact is supported by the work of Stewart (1994).

4 Closed Clamshell Bucket

The cable-controlled, closed clamshell bucket was used to remove sediment from the Mobil Oil Refinery site between baseline Stations 775+70 and 779+60 from 31 July 1992 through 4 August 1992 (no dredging on 2 August).

Bucket Design and Operation

The closed clamshell bucket used in this project was a modified opened McGinnis material handling, 4.5-cu-yd capacity, 5-cable-operated (2 hoist, 2 closing, and 1 tagline cables), center-pull bucket. Bucket modifications included welding steel plates to the top of the bucket (following the shape of the bucket) and cutting four 8-in.-diam air escape holes (two on each side with rubber bumpers around the holes) on the top of these covers. The bucket had a grab width of 10.5 ft and the bucket was 4.3 ft high by 7.6 ft wide. The bucket's empty weight was 8,250 lb. This bucket was also mounted on crane 16 and operated in a manner similar to the opened bucket.

The closed clamshell bucket was operated at a 3-min cycle time on 31 July (day 7/1) and 1 August 1992 (days 8/1-8/3), a 1-min cycle time on 3 August 1992 (days 9/1 and 9/2), and a 2-min cycle time on 3 August (day 9/3) and 4 August 1992 (days 10/1-10/3). For the given site conditions and equipment design, a 3-min cycle was representative of a slow operation. This cycle time included holding the bucket just below the water level prior to lowering to the sediment layer, to allow air to escape through the cover holes. The 1-min cycle time was representative of a normal operation (neglecting the bucket covers). The 2-min cycle time represented a compromise between normal and slow operations.

Pre-Dredging Sediment Characteristics

As previously mentioned, the summary statistics for the Mobil Oil Refinery site were calculated using all of the sediment core data collected at this site. Therefore, the pre-dredging sediment physical and chemical data associated with the closed clamshell bucket are the same as those used for the opened

clamshell bucket operating at the Mobil Oil site (Chapter 3). Summary statistics are provided in Appendix B.

Site Water

Pre-dredging water depths

Using the May 1992 sounding data, pre-dredging water depths (referred to low water datum) in the Federal channel at the Mobil Oil Refinery site (B/L Station 775+70 to 779+60 for this bucket) ranged from approximately 17 to 20 ft. Water depths at the toe of the Federal channel slope were approximately 18 ft and appeared to slope up to the water surface below (up to 8 ft) the navigation channel grade.

Post-dredging water depths

Using the 27 August 1992 sounding data, post-dredging water depths along the slope of the Federal channel at the Mobil Oil Refinery site were up 13 ft below grade. The final channel slope at both sites was greater than 1 on 3. Average end area calculations indicated that approximately 3,800 cu yd of sediment was removed by the closed clamshell bucket at this site.

Background water

TSS. Background TSS (Stations 13-15) data were collected on days 7/1, 8/1, and 3, 9/1 and 3, and 10/1 and 3. For days 7/1, 8/1 and 8/3, water velocities were greater than 0.4 fps. Therefore, TSS data for these days were grouped with similar Mobil Oil background data sets (days 5/1, 6/1, and 11/1) to summarize the data. Normality checks and F- and t-tests indicated that these data did not vary significantly (at a 0.01 level of significance) with cross section or depth. Therefore, the background TSS data for days 7/1 and 8/1 and 3 were averaged cross-sectionally and depthwise. The resulting mean background TSS concentrations for days 7/1, 8/1, and 8/3 were 194, 152, and 33.9 mg/ℓ, respectively, with standard mean errors of 11.8, 4.5, and 3.5 mg/ℓ, respectively.

Days 9/1, 9/3, and 10/1 experienced water velocities less than 0.4 fps and were grouped with data sets from days 5/4, 12/1, 12/3, 13/1, and 13/5. Normality checks and F- and t-tests indicated that these data also did not vary significantly (at a 0.01 level of significance) with cross section or depth and were averaged accordingly. The resulting mean background TSS concentration for days 9/1, 9/3, and 10/1 were 28.4, 15.8, and 34.0 mg/ℓ, respectively, with standard mean errors of 4.7, 1.6, and 2.6 mg/ℓ, respectively.

Day 10/3 experienced water velocities greater than 1.5 fps and was analyzed separately from the other data sets. Similarly to the other data sets, however, these data were normally distributed and their variance and mean did not vary significantly (at a 0.01 level of significance) with cross section or depth. As a result, these data were averaged cross-sectionally and depthwise. The resulting mean background TSS concentration for day 10/3 was 409 mg/ℓ with a standard mean error of 45.0 mg/ℓ.

An examination of the velocity data and TSS concentrations at Stations 7-9 indicated that reasonable assumptions for background TSS concentrations for days 9/2, 10/2, and 8/2 were 20, 100, and 90 mg/ℓ, respectively. A summary of the background TSS data summary statistics and assumed values for the closed bucket is provided in Appendix F.

Chemical. Water chemistry for all three dredge types is discussed in Chapter 6.

Dredging-Induced Sediment Dispersion

The closed clamshell bucket-induced TSS data corresponding to a 1-min cycle time (days 9/1 and 9/2) were grouped together. Normality checks and F- and t-tests, at a 0.01 level of significance, indicated that Stations 7-9, 5 and 6, 10-12, and 16-18 data varied with depth but not cross section; individually, Stations 0, 4, and 3 did not vary with depth; and Stations 1 and 2 did not vary with cross section or depth. These data were averaged according to these analyses and the resulting summary statistics are provided in Appendix F.

The closed clamshell bucket-induced TSS data corresponding to a 2-min cycle time (days 9/3 and 10/1-10/3) were grouped together. Normality checks and F- and t-tests, at a 0.01 level of significance, indicated that data for Stations 7-9, 1 and 2, 5 and 6, and 16-18 did not vary with cross section or depth; individually, Stations 0, 4, and 3 did not vary with depth; and Stations 10-12 did not vary with cross section but did with depth. These data were averaged according to these analyses and the resulting summary statistics are provided in Appendix F.

The closed clamshell bucket-induced TSS data corresponding to a 3-min cycle time (days 7/1 and 8/1-8/3) were grouped together. Normality checks and F- and t-tests at a 0.01 level of significance indicated that none of the stations varied with cross section or depth. These data were averaged according to these analyses and the resulting summary statistics are provided in Appendix F.

The data in Tables F6 through F8 show the mean TSS concentration above background for the closed bucket dredge. The highest value recorded is 854 mg/ℓ at the point of dredging (Station 0). A concentration of 230 mg/ℓ was observed for the near bottom sample for Stations 5 and 6 at a 1-min cycle

time. However, the concentration increases are generally less than 100 mg/ℓ. Figure 22 compares the actual suspended solids concentration means for the cross section of Stations 7-9 to the cross section for downstream Stations 10-12. The downstream concentrations are generally greater than those observed at the upstream section. The relationship between closed bucket TSS increase and bucket cycle time is shown in Figure 21. The greater increases are associated with the shorter bucket cycle times. Concentration differences for the open bucket in this plot appear to be lower than for the closed bucket at equal cycle times. The importance of this difference is lessened because of the fact that the evaluations were conducted at different locations on the river and under different and varying flow conditions. These factors may have played a larger role than the effect of the bucket during this demonstration. However, previous investigations have also noted increased resuspension for closed bucket dredging compared to open bucket dredging (McLellan et al. 1989). One explanation for the increase is the development of a greater wave ahead of the closed bucket as it falls through the water column and approaches the bottom sediment, whereas the open bucket allows more water to flow through the opened bottom and top of the open bucket.

Post-Dredging Sediment Characteristics

Chemical properties

The closed clamshell bucket post-dredging grab sediment samples had a mean pH of 7.3 (slightly basic) with a standard mean error of 0.1 and a mean TOC of 17,000 mg/kg with a standard mean error of 840 mg/kg. Like the pre-dredging sediment, all post-dredging sample PCB Aroclor concentrations were below detection. With the exception of benzo (a) anthracene (1.706 mg/kg), all mean PAH compound sediment concentrations were less than 1 mg/kg. The standard mean error associated with the benzo (a) anthracene was 1.2 mg/kg. Metal concentrations are shown in Appendix K. In general, contaminant concentrations were similar to the concentrations before dredging. The residual concentrations are likely the result of historical contamination below the depth of cut and/or spillage and re-deposition of dredged material.

5 Submersible Pump

The cable-suspended, submersible pump was used to remove sediment from the Mobil Oil Refinery site between baseline Stations 779+60 and 781+40 on 6 and 7 August 1992 and from the upstream Dead Man's Creek site between baseline Stations 561+30 and 562+80 on 8 August 1992.

Pump Design and Operation

The cable suspended submersible pump was a Toyo Pump model DP75B. This pump was an electrically driven 75-hp centrifugal pump with an 8-in.-diam discharge, maximum solids size of 2.4 in., total weight of 2,250 lb, and a non-variable speed of 1,170 rpm. The pump's impeller casing was 24 in. in diameter. The pump was equipped with a 6-in.-diam agitator (enclosed within a grated structure) and water jets that are reportedly capable of de-stabilizing high density solids (up to 70 percent by weight). The pump was mounted on the hoisting wires of crane 16. A decision was made in the field to remove the water jets for fear of creating excess sediment dispersion.

The pump's discharge line was an 8-in.-diam steel-belted rubber hose that was routed from the pump's discharge, through a metal brace (used to prevent the pipeline from kinking) that was suspended by the crane's closing wires, onto the deck of the dredge barge, and fixed to one end of the density and flow meter's 8-in. metal pipe (mounted on the dredge barge's deck). Another section of 8-in. rubber hose was routed from the flow monitoring equipment's pipe and fixed to the transportation barge's coaming. This system was installed on 5 August 1992; therefore, no dredging was accomplished on that day. Samples were collected using the sampling array fixed to the pump (Figure 6).

Facing the pump's discharge, the sampling points were numbered, from left to right, 1 through 6. However, on 6 August 1992, slack in hose numbers 4 through 6 became entangled in the pump's agitator and these hoses were rendered useless. Once the hoses were removed from the pump's intake, hose number 2 was moved to port number 6. From this point on, only ports 1, 3, and 6 were operational; however, ports 1 and 6 (upward-facing

ports) were sampled since the pump kept tilting on its side and would clog the pumps when sampling through port 3 (downward facing).

Crane 16's upper structure was rotated at approximately 90 deg of the dredge barge's center line when operating the pump. Working downslope, the crane lifted and placed the pump parallel with the dredge barge on about 50-ft reaches prior to advancing the dredge. However, downward-facing sample port TSS levels indicated that the pump continually tilted on its side. Furthermore, submerged piles at the upstream Dead Man's Creek site greatly limited pump movement and severely damaged the sampling array.

A Texas Nuclear Mark II Doppler/Density measurement system was used to provide slurry velocity (feet per second) and density (grams per cubic centimeter) and instantaneous solids production rate (cubic yards per hour). Computer hardware and a GLDD data logging program were used to acquire and store the measured data. These data indicate that the slurry velocity ranged from approximately 4 to 15 fps and slurry density averaged 1.01 to 1.02 g/cm^3 (water is 1.0 g/cm^3). A summary of the pump's instantaneous production rate is provided in Table 5. MATLAB software was used to plot a 4-sec average of slurry velocity, density, and production data with time. Sporadic meter readings were observed as a result of the low slurry densities, as the meter's accuracy decreases with slurry density.

Pre-Dredging Sediment Characteristics

As previously mentioned, the summary statistics for the Mobil Oil Refinery site were calculated using all of the sediment core data collected at this site. Therefore, the pre-dredging sediment physical and chemical data associated with the submersible pump operation at this site is the same as that used for the opened and closed clamshell buckets (Chapter 3). Summary statistics for this site are provided in Appendix B.

A description of the upstream Dead Man's Creek (B/L Stations 560+75 to 563+00) pre-dredging sediment sampling core locations, sampling techniques and personnel, sample preservation and analysis, and statistical analysis was provided in Chapter 2 of this report. This section discusses the summary statistics of the physical and chemical properties of the pre-dredging sediment cores as they pertain to the submersible pump operation.

Physical properties

The grain size distribution range of the upstream Dead Man's Creek is provided in Figure 18. The Atterberg limits, USCS classification, and percent total solids for the various core intervals at this site are provided in Appendix A. Summary statistics for the Atterberg limits and percent solids are provided in Appendix B.

All of the upstream Dead Man's Creek sediment cores showed silt and clay-size particles. Based on the grain size distribution and Atterberg limit data, all of the sediment core intervals had a USCS classification of ML. The sediment had a relatively low mean liquid limit of 37.0 percent and a mean plastic limit of 29.3 percent. Standard mean errors of the liquid and plastic limits were 1.8 and 1.9, respectively. The sediment also had a mean percent total solids of 66.0 percent, which equated to a water content of 52 percent. Like the other two sites, this sediment can be easily penetrated but may not flow easily. The standard mean error for total solids was 2.9 percent.

Chemical properties

Chemical conditions at the upstream Dead Man's Creek site are summarized in Appendix B.

The upstream Dead Man's Creek sediment cores had a mean pH of 7.5. These data indicate that the sediment cores were slightly alkaline or basic. The standard mean error of these data was 0.1. The sediment cores had a mean TOC of 29,000 mg/kg with a standard mean error of 3,100 mg/kg. The sediment core interval concentrations of PCB Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260 were below detection. However, USEPA (1992) indicated a mean total PCB concentration of 6.1 mg/kg at this site with a standard mean error of 1.3 mg/kg. As previously mentioned, comparisons with the standards indicated that these data were biased slightly high. Mean values for fluorene, phenanthrene, fluoranthene, pyrene, benzo (k) fluoranthene, and benzo (a) pyrene were 1.8, 7.9, 9.6, 3.6, 1.3, and 2.0 mg/kg, respectively. The remaining PAH compounds were found at concentrations less than 1 mg/kg. The USEPA (1992) indicated a mean total PAH concentration of 390 mg/kg at this site with a mean error of 93 mg/kg. Like the other two sites, a comparison between the individual PAH compounds and total PAH concentrations indicates a large difference in measured PAH.

Water Conditions

Pre-dredging water depths

The May 1992 sounding data indicated pre-dredging water depths in the Federal channel at the Mobil Oil Refinery site ranged from approximately 17 to 20 ft. Water depths at the toe of Federal channel slope ranged from approximately 18 to 21 ft.

Using the April 1992 sounding data, pre-dredging water depths in the Federal channel at the upstream Dead Man's Creek site ranged from approximately 23 to 27 ft. Water depths at the toe of the Federal channel slope were approximately 23 ft (or below grade).

Post-dredging water depths

Using the 27 August 1992 sounding data, post-dredging water depths along the slope of the Federal channel at the Mobil Oil Refinery site were up to 8 ft below grade. Post-dredging water depths along the slope of the Federal channel at the upstream Dead Man's Creek site were up to 10 ft below grade. The final channel slope at the Mobil Oil site appeared greater than 1V on 3H; however, the final slope at the Dead Man's Creek site was approximately at grade. The production meter indicated approximately 145 cu yd of material was removed. Cross-section end area computations indicated that 1,600 cu yd of sediment was removed by the submersible pump at the Mobil Oil Refinery site and 200 yd^3 at the upstream Dead Man's Creek site. The additional material estimated by the end area method is likely the result of the maintenance dredging activity that followed the environmental dredging demonstration.

Background water

TSS. The submersible pump was operated on 6 August (days 12/1-12/3) and 7 August 1992 (days 13/1-13/5) at the Mobil Oil Refinery and 8 August 1994 (days 14/1-14/3) at the Upstream Dead Man's Creek sites. However, background TSS (Stations 13-15) data were collected on days 12/1, 12/3, 13/1, 13/5, 14/1, and 14/3. Days 12/1, 12/3, 13/1, and 13/5 experienced water velocities less than 0.4 fps and were grouped with similar Mobil Oil background data sets (days 5/4, 9/1, 9/3, and 10/1) to determine an acceptable method for summarizing the data. Normality checks and F- and t-tests indicated that these data did not vary significantly (at a 0.01 level of significance) with cross section or depth. Therefore, the background TSS data for days 12/1, 12/3, 13/1, and 13/5 were averaged cross-sectionally and depthwise. The resulting mean background TSS concentrations for days 12/1, 12/3, 13/1, and 13/5 were 32.1, 18.7, 37.5, and 14.0 mg/ℓ, respectively, with standard mean errors of 2.6, 1.0, 6.8, and 0.8 mg/ℓ, respectively.

Days 14/1 and 14/3 also experienced water velocities less than 0.4 fps and were grouped with similar Dead Man's Creek background data sets (days 3/1, 13/3, 4/1, and 4/3). Normality checks and F- and t-tests indicated that these data also did not vary significantly (at a 0.01 level of significance) with cross section or depth and were averaged accordingly. The resulting mean background TSS concentrations for days 14/1 and 14/3 were 18.2 and 14.7, respectively, with standard mean errors of 1.8 and 0.9 mg/ℓ, respectively.

An examination of the velocity data and TSS concentrations at Stations 7-9 indicated that a reasonable assumption for background TSS concentrations for days 12/2, 13/2-13/4, and 14/2 were 25, 30, 25, 20, and 15 mg/ℓ, respectively. Background TSS data statistics and assumed values for the submersible pump are summarized in Appendix F.

Chemical. Chemical data collected during the submersible pump operation are discussed in Chapter 6.

Dredging-Induced Sediment Dispersion

Submersible pump operations at the Mobil Oil Refinery and Upstream Dead Man's Creek sites were considered separately, since pump operation was greatly hindered at the Creek site. Furthermore, the upstream and downstream station locations were substantially different at the two sites. With this in mind, the pump-induced TSS concentrations at the two sites were summarized separately.

As the pump was cable-suspended, it was very difficult to position and move. In addition, the pump operated at a continuous speed (impeller and agitator). Therefore, the operation of the submersible pump was not varied over the 3 demonstration days.

The submersible pump-induced TSS data at the Mobil Oil site (days 12/1-12/3 and 13/1-13/5) were grouped together. Normality checks and F- and t-tests, at a 0.01 level of significance, indicated that Stations 7-9, 5 and 6, and 10-12 data varied with depth but not cross section; individually, Stations 4 and 3 did not vary with depth; and Stations 1 and 2 and 16-18 did not vary with cross section or depth. These data were averaged according to these analyses and the resulting summary statistics are provided in Appendix F.

The submersible pump-induced TSS data at the upstream Deadman's Creek site (days 14/1-14/3) were grouped together. Normality checks and F- and t-tests, at a 0.01 level of significance, indicated that none of the stations varied with cross section or depth. These data were averaged according to these analyses and the resulting summary statistics are provided in Appendix F.

Tables F9 and F10 in Appendix F show a maximum TSS concentration during pump operation of 85 mg/ℓ at Station 3. This appears to be atypical, since most of the increases are less than 50 mg/ℓ. TSS comparisons for the upstream and downstream cross sections are illustrated in Figure 23. Most of these increases are less than 25 mg/ℓ.

Post-Dredging Sediment Characteristics

Chemical properties

The submersible pump remediated Mobil Oil Refinery post-dredging grab sediment samples had a mean pH of 7.4 (slightly basic) with a standard mean error of 0.1 and a mean TOC of 15,000 mg/kg with a standard mean error of

560 mg/kg. Like the pre-dredging sediment, all post-dredging sample PCB Aroclor concentrations were below detection. With the exception of fluoranthene (1.1 mg/kg), benzo(a)anthracene (4.5 mg/kg), and indeno(1,2,3-cd) pyrene (1.2 mg/kg), mean PAH compound sediment concentrations were less than 1 mg/kg. The standard mean error associated with the fluoranthene, benzo(a)anthracene, and indeno(1,2,3-cd)pyrene were 0.25, 2.6, and 0.86 mg/kg, respectively. Metal concentrations were similar to the pre-dredging sediment.

The post-dredging Upstream Dead Man's Creek grab sediment samples had a mean pH of 6.7 (slightly acidic) with a standard mean error of 0.0 and a mean TOC of 12,800 mg/kg with a standard mean error of 466 mg/kg. Like the pre-dredging sediment, all post-dredging sediment sample PCB Aroclor concentrations were below detection. In addition, PAH compound sediment concentrations were less than 1 mg/kg. Metal concentrations were similar to the pre-dredging sediment.

6 Contaminant Releases During Dredging

One of the major environmental concerns associated with dredging contaminated sediments is the potential for release of contaminants to the water column. These contaminants may cause toxicity to aquatic organisms in the immediate vicinity of the dredging operation or may be transported downstream and affect other receptors. One of the objectives of the dredging demonstration was to assess the water column releases from the three dredges evaluated. As part of this objective, the applicability of a laboratory test as a predictive technique for contaminant releases was considered.

Water Column Concentrations

Heavy metals

Heavy metal concentrations observed during the dredging demonstration are reported in Appendix G. Both total and filtered (dissolved) concentrations were measured for chromium, copper, lead, and zinc. Mean concentrations and standard deviations for all observations during the project are plotted in Figures 24 through 27 for the four metals versus station number from upstream to downstream. These plots show that total metal concentrations were elevated in the immediate vicinity of the dredge (Station 00) and generally decreased with distance from the dredge. This decrease is likely a result of settlement of suspended particles and dilution. The error bars on the plots demonstrate that there is little statistical difference in the concentrations above background (Stations 13-15). The figures also show that the dissolved concentrations for the four metals were not observed to be affected by the dredging activity. Chromium and lead concentrations were near the detection limit.

Extreme (highest) heavy metal concentrations observed during each project day are compared to NYDEC water quality standards in Appendix H. Although the extreme values were greater than the Class D standards for copper, lead, and zinc, the mean values for dissolved concentrations of these metals (illustrated in Figures 24 through 27) are less than the Class D standards.

PCBs and PAHs

A limited number of samples were collected and analyzed for PCBs and PAHs in the water column. Extraordinary analytical techniques and large sample volumes were required to detect these contaminants at the low levels present in the Buffalo River, both prior to and after dredging. Results of these analyses are presented in Table 6.

Dissolved PCB concentrations in Table 6 show that the highest concentration observed was 3.28 ng/ℓ on 24 July, which was prior to dredging and during a rainfall event. The highest suspended PCB concentration (9.91 ng/ℓ) was observed on 31 July while dredging with the opened and closed bucket dredges at the Mobil Oil site. However, a rainfall event of 1.47 in. was observed on this date.

The dissolved PAH concentrations shown in Table 6 are generally less than 4 ng/ℓ and may have been affected by rainfall. The highest suspended concentrations for the PAHs analyzed were recorded on 31 July when the major rainfall event was observed. Concentrations during dredging at the Mobil Oil site remained elevated, but insufficient data are available to sort out the effect of the dredging activity.

Dredging Elutriate Test (DRET)

The Corps of Engineers has developed the DRET as a means of estimating contaminant releases during dredging. This test is a modification of the standard elutriate test that is used for open water disposal of dredged material and the modified elutriate test that is used to predict effluent quality from a confined disposal facility. The original development of this test was reported by DiGiano, Miller, and Yoon (1993).

The basic steps for the DRET include mixing sediment to be dredged with site water at a slurry concentration of 10 g/ℓ sediment solids. The mixture is mixed with air in a 4-ℓ graduated cylinder for 1 hr, followed by settling for 1 hr. The supernatant is decanted and separated into total and dissolved fractions by centrifugation and filtration. The two samples are then analyzed for contaminants of concern. DiGiano, Miller, and Yoon (1993) showed that this test is a conservative (high) estimate of water column concentrations in the vicinity of the dredge.

As part of the Buffalo River demonstration, three sediment samples were subjected to the DRET--one each from the downstream Dead Man's Creek site, the upstream Dead Man's Creek site, and the Mobil Oil site. Triplicate tests were performed on each sample. Results are summarized in Appendix J. Typical results for the tests are illustrated in Figures 28 and 29 for lead and zinc--total and dissolved, respectively. These figures demonstrate that the DRET predicts water column concentrations within an order of magnitude for

total and dissolved concentrations and that the DRET generally overestimates water column concentrations. PCB and PAH concentrations in the water column were insufficient to compare to the tests.

7 Acute Toxicity Testing with *Daphnia Magna*

Introduction

Because of the difficulty in measuring low contaminant concentrations in water, biological tests are often considered as a means of evaluating low-level contaminant releases and potentially toxic effects. One organism that has been used for such evaluations in fresh water is *Daphnia magna*.

Buffalo River water samples were shipped to WES in 0.5-gal glass jars in ice chests with ice and arrived intact. They were stored at 4 °C until testing for acute toxicity. A total of 26 samples were tested. Acute bioassays were conducted on an unfiltered and a filtered subsample for each sample received.

Daphnia magna were tested in 1-ℓ glass beakers containing 250 ml of unfiltered or filtered (0.7-μ filters) water samples taken near the dredging operation. These tests were static acute toxicity tests of undiluted water samples that generally followed procedures discussed in American Society for Testing and Materials (ASTM) Standard E 1192-88 (ASTM 1991) for conducting acute toxicity tests on aqueous effluents. The *Daphnia magna* test procedures also followed methods used during the USEPA ARCS studies of Great Lakes AOC's (Ingersoll et al. 1992).

Materials and Methods

Buffalo River water samples were removed from the cold room and allowed to adjust to room temperature (23-25 °C) prior to toxicity testing. Most of these samples were tested for suspended solids. All samples were tested for pH and dissolved oxygen levels prior to starting the bioassays. The water samples were poured into the test beakers and either 5 or 10 *Daphnia magna*, aged 48 to 72 hr, were added to each beaker. Control beakers were prepared with the laboratory water used to culture the daphnids, i.e., aged tap water and reverse osmosis water. For each Buffalo River water sample tested, there were four or five replicate beakers with 250 ml of sample or

control water. Most of the tests were run for 96 hr, or 4 days. Some of the tests were terminated at either 48 or 72 hr because they were follow-up tests or control mortalities were observed.

Results and Discussion

The toxicity data, suspended solids readings, and pH data are shown for each of the water samples in Tables N1 through N8 in Appendix N. The dissolved oxygen (DO) concentrations for all of the samples were 6.0 to 7.0 ppm or greater. These DO concentrations were satisfactory, i.e., not harmful, to the test animals. The water samples did not appear to be highly contaminated based on the DO levels, the lack of any odor characteristic of oil or chemicals, and their general clarity and appearance. A few of the bioassays were repeated. Data for the repeat tests are shown in tables labeled "Second Test." These tests reveal few cases where the Buffalo River water samples were shown to be acutely toxic to the test organism when compared to the controls, for each of the bioassays. *Daphnia magna* are generally very sensitive to aquatic contaminants and either reveal toxicity or grow and reproduce. Control survival should be 80 percent or better (Moore et al. 1994). The data showing control mortalities greater than 20 percent indicate some problem either with the general laboratory conditions or the test animals themselves. The following bioassays revealed unacceptable control mortalities: Table N3 (70 percent) and Table N4 (60 percent).

Although there were few cases of acute toxicity, it was observed that there were many cases where the test animals did not exhibit good growth and/or reproductive activity in the Buffalo River water samples. This is somewhat unusual for water samples that are not acutely toxic. There were cases where the data showed acute toxicity, i.e., the test animals were adversely affected by these samples. Toxicity, for the purposes of this report, was indicated when survival of test animals was 20 percent less than the controls.

This analysis found a total of six water samples to be toxic. These samples are summarized in Table 7. On two occasions, 28 July and 4 August, toxicity was observed both upstream and downstream of the dredging operation. A fifth toxic sample was collected before dredging began on 24 July. Only one sample near the dredge showed toxicity. This suggests that dredging contaminated sediments in the Buffalo River did not produce acute toxicity effects as measured by *Daphnia magna*.

One bioassay of the filtered Buffalo samples (Table N5) had generally good control survival and at least four of the filtered samples showed some degree of toxicity. *Daphnia magna* exposed to the filtered samples, in many cases, did not reveal 80 or 90 percent survival as would be expected for water samples that were not toxic. However, as noted above, the toxicity was noted in samples taken prior to the first day of dredging and for upstream as well as downstream samples. The apparent toxicity may be caused by contaminants routinely found in the Buffalo River system or by pollution from storm runoff.

8 Sediment Dispersion Barrier Effectiveness

Barrier Design and Deployment

A 22-ft textile sediment dispersion barrier was installed around the open clamshell bucket operation at the downstream Dead Man's Creek site (see Figures 7 and 14). The barrier was constructed of 100-ft sections of 22-ft-deep (two 11-ft-wide × 100-ft-long sections seamed together) Exxon Chemical Corporation's GTF 400E synthetic geotextile fabric (Table 8). Each 100-ft section contained four circular styrofoam flotation packs, a steel tension cable on top, and a chain at the bottom. The steel cables were used to provide structural integrity while the chains were used for ballast.

Seven individual 100-ft barrier sections, with the fabric rolled around the flotation, were delivered to the project site on a deck barge. When ready for deployment, each 100-ft section was removed from the stern of the barge and joined with another section; the first section removed from the barge was fixed to the bow of the barge to hold the barrier in place during assembly. The seven 100-ft barrier sections were laced together using steel cable running through eight steel grommets located along the 22-ft depth of the barrier. The tops of the sections were also joined by their steel tension cables.

The sediment dispersion barrier's tension cable was fixed to rocks on the downstream shore of Dead Man's Creek and deployed at approximately a 6-deg angle to this shoreline. The barrier was fixed at the river end of the first 100-ft section by a 400-lb concrete anchor (several concrete blocks). Running parallel to the river's shoreline, twelve 20-lb Danforth anchors, attached to the tension cables, were used to fix the next six sections in place. The end of the barrier was fixed to a 200-lb anchor.

In spite of the above anchorage, the barrier broke loose of its anchorage on 27 July 1992 after experiencing 0.1- to 0.3-fps water velocities. The barrier was retrieved by the tugboat *Mackie* and suffered some damage from the tug's prop. On 28 July 1992, the barrier was anchored to the river shoreline and the port side of the transportation barge's stern. On 29 July 1992, the barrier was anchored to the shoreline and the mid-stern of the dredge barge. These

deployment methods managed to keep the barrier in place during 0.0- to 0.4-fps water velocities.

TSS Containment

Bucket-induced TSS concentration

The open clamshell bucket described in Chapter 2 was operated at a 2-min cycle time on 28 July (days 3/1 and 3/2) and 29 July 1992 (days 4/2 and 4/3) and a 4-min cycle on 28 July (day 3/3) and 29 July 1992 (day 4/1). For the given site conditions and equipment design, a 4-min cycle was representative of a slow operation. A 2-min cycle was representative of a normal operation.

Similar to the bucket and pump-induced TSS data summaries, the bucket/barrier-induced TSS concentration data were evaluated by subtracting the mean background TSS concentrations from Stations 0-12 and 16-18. Stations near the dredge (0, 1, and 3), stations inside the barrier (2 and 5), and stations outside the barrier (4 and 6) were of particular interest in evaluating the open bucket-induced TSS concentrations and the effectiveness of the barrier at containing these releases.

The open clamshell bucket-induced TSS data corresponding to a 2-min cycle time (days 3/1 and 3/2 and 4/2 and 4/3) were grouped together. Normality checks and F- and t-tests, at a 0.01 level of significance, indicated that Stations 0 or 1 did not vary with depth; however, Station 3 did vary with depth. The resulting mean TSS concentrations indicated that this open clamshell bucket operation introduced approximately 20 to 25 mg/ℓ TSS to the water column. Results of the statistical evaluations on all stations and cycle times are provided in Appendix F.

The open clamshell bucket-induced TSS data corresponding to a 4-min cycle time (days 3/3 and 4/1) were grouped together. Normality checks and F- and t-tests, at a 0.01 level of significance, indicated that Stations 0, 1, and 3 did not vary with cross section or depth. The resulting mean TSS concentrations indicated that this open clamshell bucket operation operated with little (10 mg/ℓ) to no TSS to the water column.

The open clamshell bucket TSS data corresponding to the unrecorded cycle time(s) (days 2/1-3) were grouped together. Similar statistical evaluations indicated that Stations 0, 1, and 3 also did not vary with cross section or depth. Results indicated that the open clamshell bucket in this operation generated between 10 and 20 mg/ℓ TSS.

Inside and outside barrier TSS concentrations

The TSS concentrations above background at the stations inside (Stations 2 and 5) and outside (Stations 4 and 6) the barrier and corresponding to a 2-min bucket cycle time were analyzed in a manner similar to the dredges. These analyses indicated that none of the station TSS concentrations varied significantly with depth. Results (Table F1) indicated that, similar to the above-mentioned TSS concentrations, the mean TSS concentrations inside the barrier were approximately 17 mg/ℓ. The mean TSS concentrations outside the barrier fell to approximately 12 mg/ℓ or a 30-percent reduction in the TSS concentration.

Analyses of the TSS concentrations inside and outside the barrier and corresponding to a 4-min bucket cycle time (Table F2) also indicated that none of the TSS concentrations at each station varied significantly with depth. At 10 to 20 mg/ℓ, bucket-induced TSS concentrations inside the barrier were slightly higher than those summarized near the dredge. The mean TSS concentrations outside the barrier either fell to zero or remained the same.

Analyses of the TSS concentrations inside and outside the barrier and corresponding to the cycle time(s) for day 4 (Table F3) indicated that TSS data for Stations 2, 4, and 5 varied with depth. Station 6 TSS data did not vary with depth. Results indicated that the 10- to 20-mg/ℓ mean TSS concentrations summarized near the bucket had settled to the low water column at the stations just inside the barrier. The mean TSS concentrations inside the barrier and at the lower water column ranged from approximately 30 to 70 mg/ℓ at Station 2 and 20 to 30 mg/ℓ at Station 5. The mean TSS concentrations outside the barrier and at the lower column fell to approximately 10 to 20 mg/ℓ at Station 4 and to approximately zero at Station 6 (throughout the water column).

Paired observations for Stations 2 and 4 for each sampling time during 27-29 July are illustrated in Figure 30. These concentrations were not adjusted for background. This figure shows that the mean concentrations outside the barrier (Station 4) are generally less than that inside the barrier (Station 2). However, the error bars for these observations show that the differences are within the confidence interval for the data sets. Mean values are higher outside the curtain than inside; this may be due to normal variance of the data or to sampling or analytical error.

9 Dredged Material Transportation Barge Supernatant Clarification

Dewatering of slurries has been successfully accomplished by the proper use of polymers in flocculating the fine particulate matter suspended in mineral processing streams. The U.S. Bureau of Mines (USBM) entered into a cooperative research effort with the Buffalo District for the purpose of testing and demonstrating the applicability of mining flocculation technology to dredging activities associated with the removal of sediments from the Buffalo River. The Buffalo River dredging demonstrated a submersible pump as a hydraulic dredging option which was hoped to reduce resuspension of sediments by the dredging operation. The submersible pump generated larger quantities of water than the bucket dredges. The transportation of this "excess" water adds to the cost of sediment removal and treatment. If this excess water can be separated from the suspended solids and returned to the water body immediately, transportation costs for the dredged material can be reduced by allowing more economical payloads for barge or scow transport. This technique could also be applied to excess turbid water generated by bucket dredges, which is often allowed to overflow the transportation barge.

The pilot process demonstrated by the USBM consisted of feed material from the barge being pumped through a 4-in. line by a centrifugal pump and exiting through a 4-in. PVC delivery system. A 1,000-gal fiberglass tank was used to mix the polymer concentrate. The polymer was pumped through a 1-in. line using a variable speed progressive cavity pump and introduced to the 4-in. feed line prior to passing through a 6-in. by 2-ft static mixer. The polymer/feed slurry traveled to the clarifying tank where the flocculated material settled to the bottom and allowed "clean" water to exit the overflow.

A pilot scale flocculation unit was operated onsite at the Corps' Confined Disposal Facility (CDF) No. 4 in Buffalo, NY. A loaded barge was delivered to the disposal facility for the flocculation studies. Contaminated sediments were pumped from the barge to the flocculation unit. Tests were conducted using polymer concentrations of 0.01, 0.02, and 0.03 percent, pumped at variable flow rates. Feed slurry from the barge consisting of approximately 1.5 percent solids was pumped through the unit at approximately 230 gal/min.

The Nephelometric Turbidity Units (NTU) values (turbidity of the water is determined by measuring the light scattered at 90 or 270 deg through the incident beam) of the discharge water ranged from 12 to 17, with the underflow discharge containing approximately 31 percent solids.

Costs associated with the polymer treatment were calculated from the original costs of the polymer when purchased in bulk ($0.50/lb). Treatment of 1,000 gal of 1.5-percent-contaminated river sediments requires less than $0.01 of polymer.

A full report of the USBM evaluation is provided at Appendix M.

10 Conclusions and Recommendations

General

The Buffalo River Environmental Dredging Demonstration Project evaluated the following technologies for application to the dredging of contaminated sediments:

a. Conventional open bucket clamshell dredge.

b. Closed bucket clamshell dredge.

c. Submersible pump hydraulic dredge.

d. Geotextile sediment dispersion barrier (silt curtain).

e. Polymer injection and flocculation for clarification of barge supernatant.

Approximately 8,000 cu yd of contaminated sediment were removed from the Buffalo River and placed in the Buffalo CDF No. 4.

Conclusions

A comprehensive monitoring program was conducted by a team of several organizations, including the Buffalo District and WES, Buffalo State College, and ARDL, Inc. Heavy rains during the test period introduced variable background suspended solids and contaminant concentrations and hindered data interpretation. Results of the monitoring and evaluation program are as follows:

a. Dredging increased water column TSS concentrations by approximately 10 to 50 mg/ℓ 500 ft downstream of the dredges. These concentration increases are in the range of water column TSS concentrations reported previously by McLellan et al. (1989) and Herbich and Brahme (1991).

b. This evaluation of the open bucket, closed bucket, and submersible pump demonstrated little difference in sediment resuspension for these dredges based on water column TSS concentrations observed downstream of each dredge. The variability in background TSS concentrations and the differences in the Dead Man's Creek and Mobil Oil sites masked differences that may have been noted otherwise.

c. Longer bucket cycle times and slower production rates generally reduced suspended sediment concentration increases in the water column for the bucket dredges. However, longer cycle times increase the duration of the project and the time period that the river's water quality is affected by the dredging. Furthermore, the total mass of suspended solids released for a given volume dredged may not be improved by longer cycle times.

d. The geotextile sediment dispersion barrier used for this project slightly reduced suspended solids concentrations downstream of the open bucket dredge. Mean TSS concentrations induced by dredging were observed to be as much as 30 percent lower outside the barrier compared to inside the barrier.

e. Heavy metal concentrations associated with water column suspended material were somewhat higher at the point of dredging, but were not significantly above background at points downstream of the dredge. Mean heavy metals concentrations observed during the project did not exceed water quality criteria established by NYDEC for Class D streams.

f. PCB and PAH concentrations in the water column downstream of the dredge appeared to be more affected by rainfall events than dredging activities.

g. The dredging elutriate test (DRET) proved to be a conservative (protective of the environment) estimator of heavy metal concentrations at the point of dredging.

h. *Daphnia magna* toxicity testing showed no acute toxicity to this organism as a result of the dredging project. However, it was noted that the test organisms did not grow and reproduce in the Buffalo River samples, suggesting that the organisms were impacted.

i. Analyses of sediment before and after dredging showed contaminants were similar for the surface layer. Residual contamination after dredging is attributed to constraints for this demonstration project that prevented excavation beyond the nominal bounds of the navigation channel. An environmental dredging project without ties to the navigation program would allow excavation to the depth and limits of contamination and would yield a cleaner post-dredging sediment.

j. The polymer injection and flocculation system successfully removed suspended solids from water pumped from the barge to the CDF. The polymer produced a floc that rapidly settled in a pilot-scale settling tank. The injection system, in-line mixing device, polymer technology, and flocculation process are proven and available. The USBM's concept for onsite clarification of supernatant from a hydraulic dredging operation at the dredging site was not fully tested by this project. Monitoring, compliance with water quality criteria, operational control, and scheduling of alternating barges would be required to demonstrate the concept for a full-scale project.

Recommendations

a. Clamshell bucket dredges or other mechanical dredge types are well-suited for environmental dredging of sites like the Buffalo River where the contaminated material is located in a small part of the river cross section, where debris and obstacles may be encountered, and where the dredged material must be transported long distances to the disposal site. These conditions limit the use of hydraulic dredges. The results of this demonstration project indicate that Buffalo River contaminated sediment can be carefully dredged using conventional equipment and removed from the aquatic ecosystem without major environmental impacts resulting from sediment resuspension, contaminant release, and toxicity. Water column TSS concentrations may be held at a lower level with slower operation of the bucket at the expense of a loss in production rate.

b. The precision of removal for all of the dredges tested was inadequate to ensure removal of the contaminated sediment to a given elevation. Improved operational controls for positioning and depth of cut are needed for environmental dredging.

c. The submersible pump was not suitable for dredging this site. Its mechanical cutting capability was inadequate for consolidated materials. Its production rate ranged from 2 to 17 cu yd per hour, and its low solids concentration in the pumped slurry resulted in excessive water being entrained during dredging. This excess water could be potentially contaminated during environmental dredging projects and require treatment. The submersible pump also did not produce a smooth cut in the sediment because its advancement was achieved simply by raising and lowering the pump with the crane and cable system. Operation of the submersible pump would have been improved if a fixed arm or ladder, rather than the sling system used by GLDD, had been used for movement and positioning of the dredge.

d. Sediment dispersion barriers using permeable geotextile materials offer limited containment of TSS from dredging operations. They should be used only for slow currents, stable water levels, and relatively shallow

depths. The sediment dispersion barrier must be adequately anchored to hold its position. Removal of the barrier and its anchors will release suspended material to the water column. Re-deployment of the barrier system offers operational challenges.

e. The depth of cut and area dredged for an environmental dredging project should be based on the extent of contamination. An effective real-time monitoring program is needed to evaluate progress toward uncovering clean material. The construction contract must be written to allow flexibility in operations and field corrections due to changing site conditions.

f. The use of polymer flocculation for barge supernatant should be demonstrated at a larger scale and in conjunction with the dredging part of the project.

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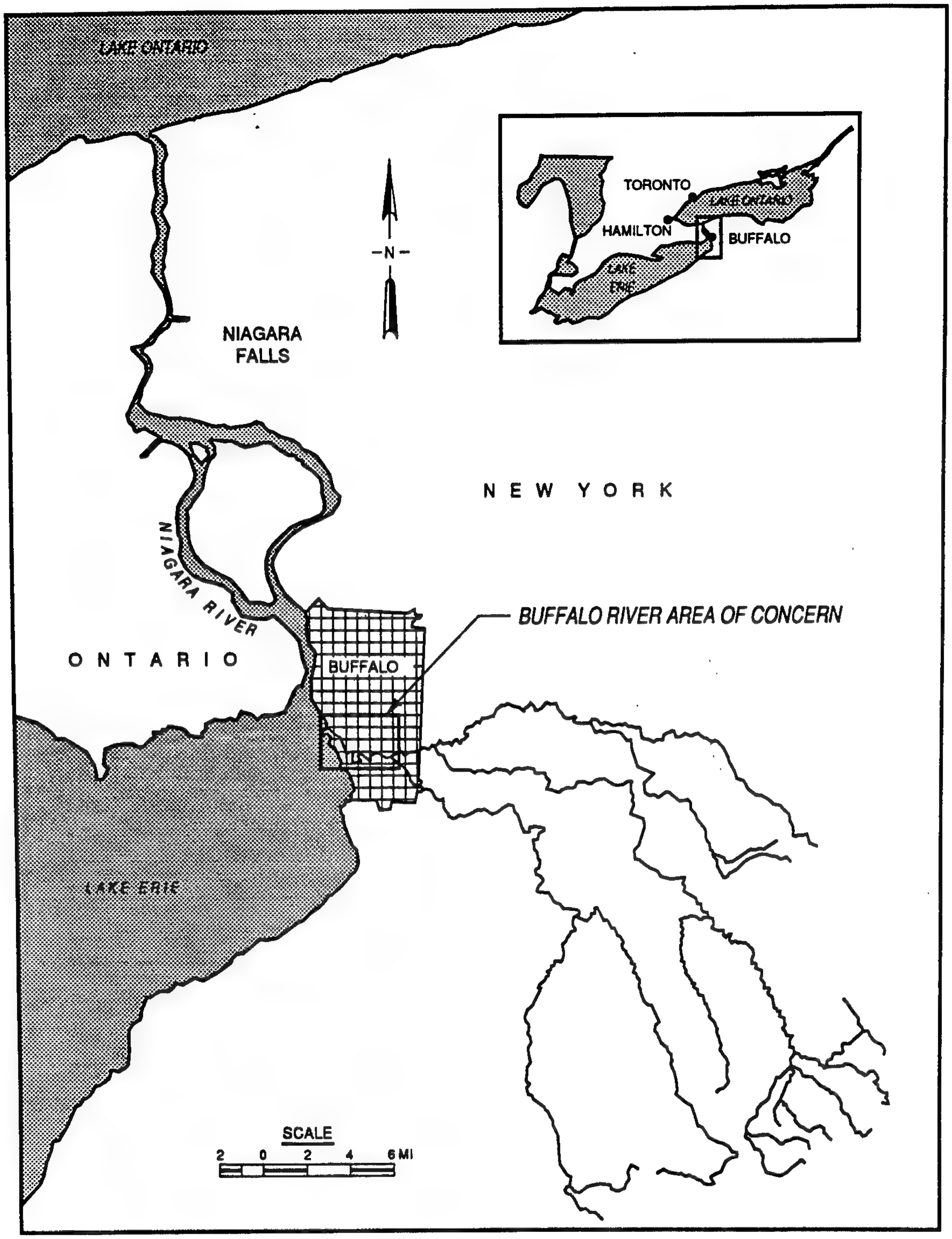


Figure 1. Buffalo River location

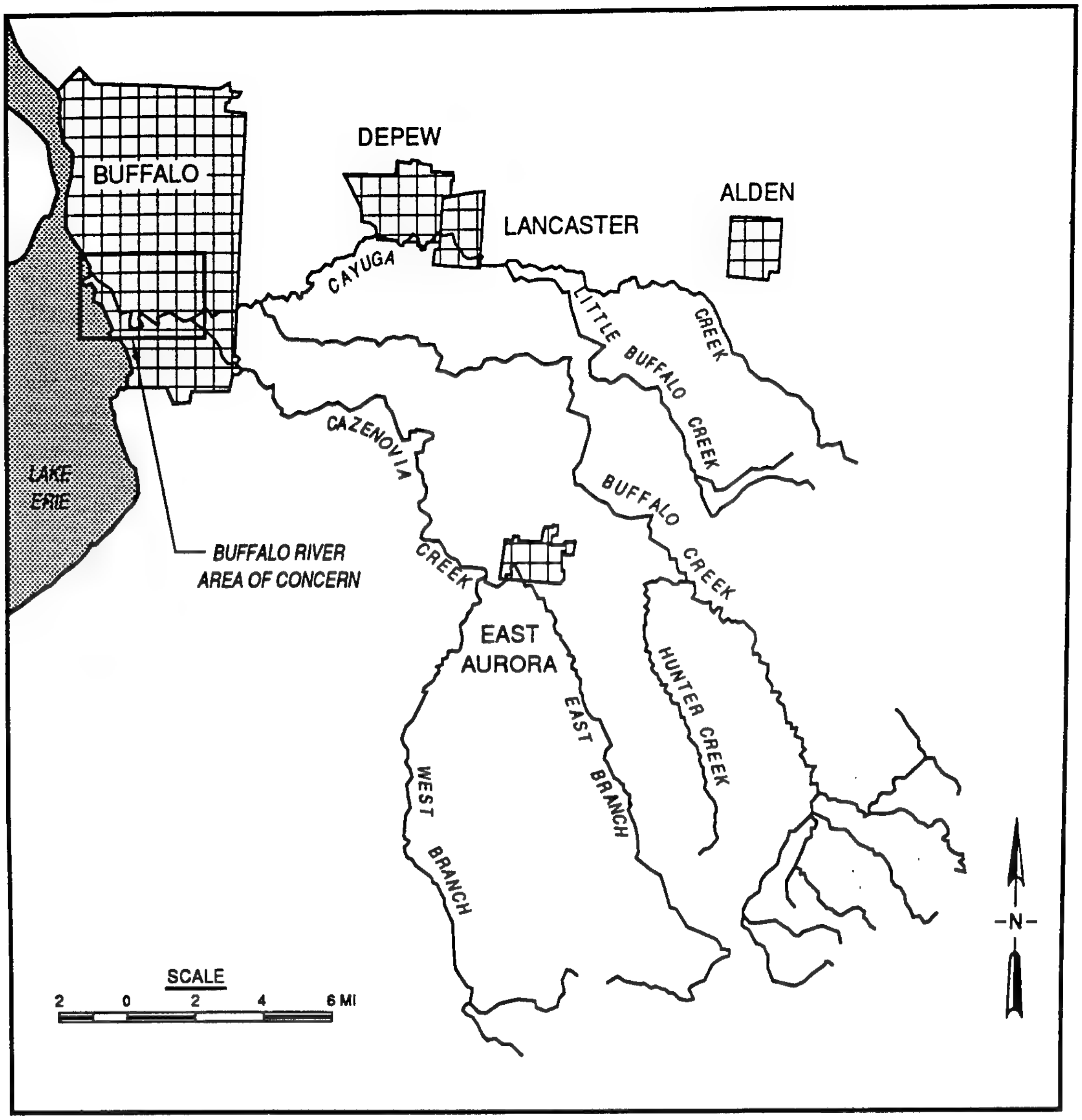


Figure 2. Buffalo River and tributaries

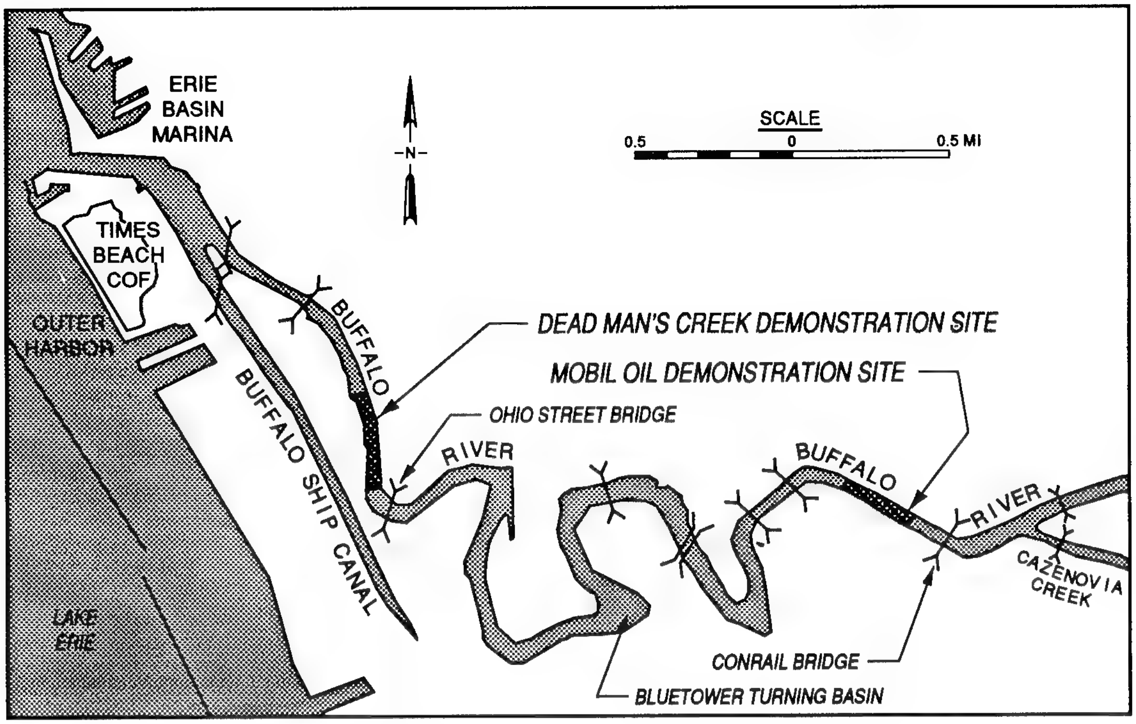
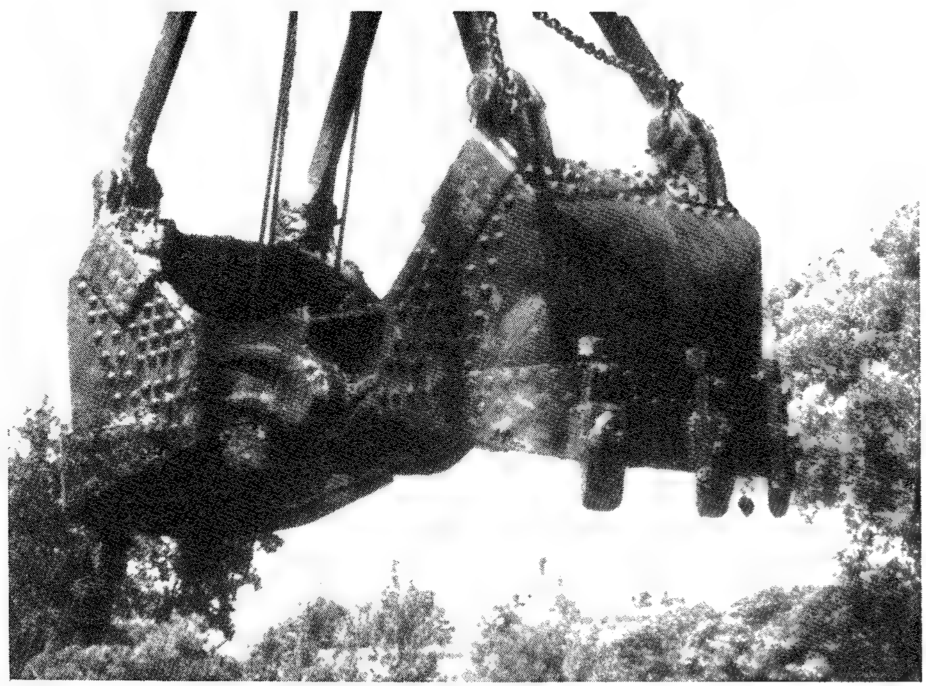


Figure 3. Dredging demonstration sites



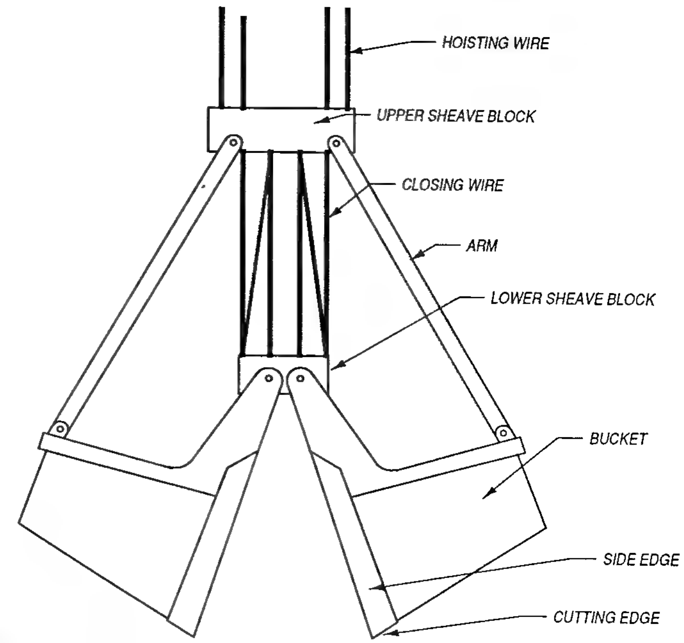
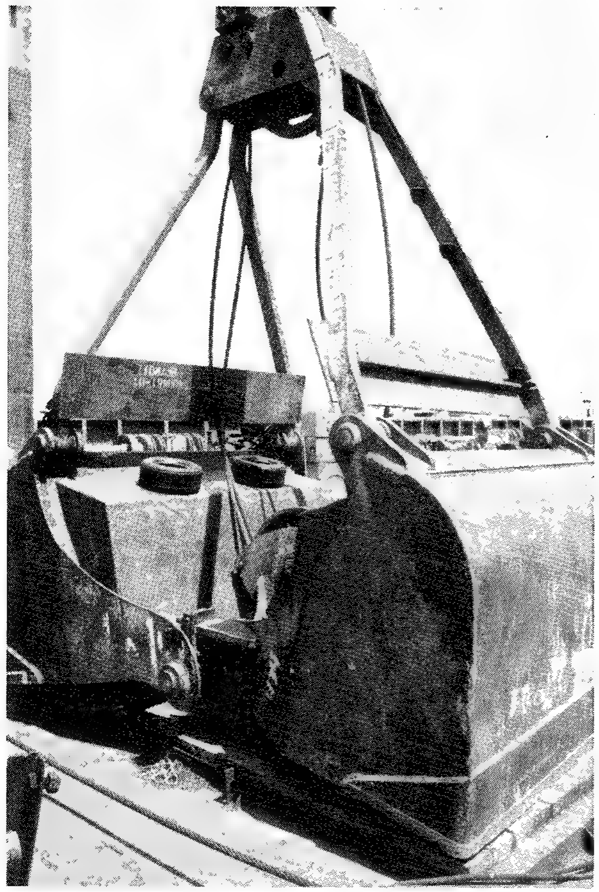


Figure 4. Opened clamshell bucket



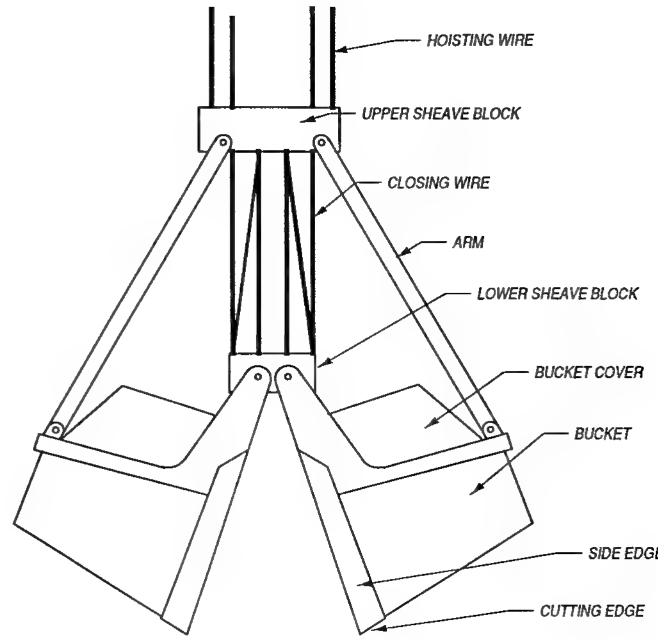


Figure 5. Closed clamshell bucket

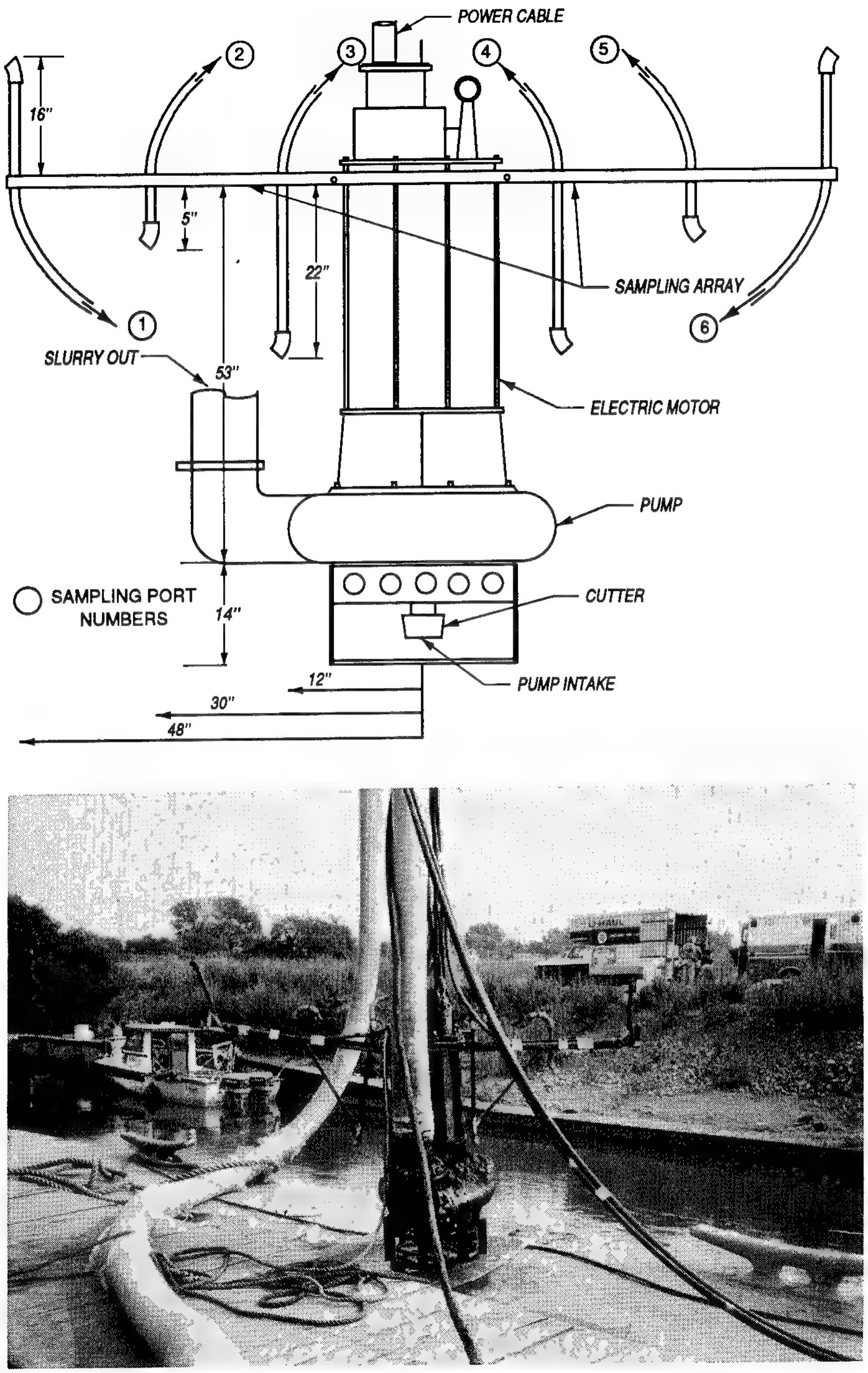


Figure 6. Submersible pump

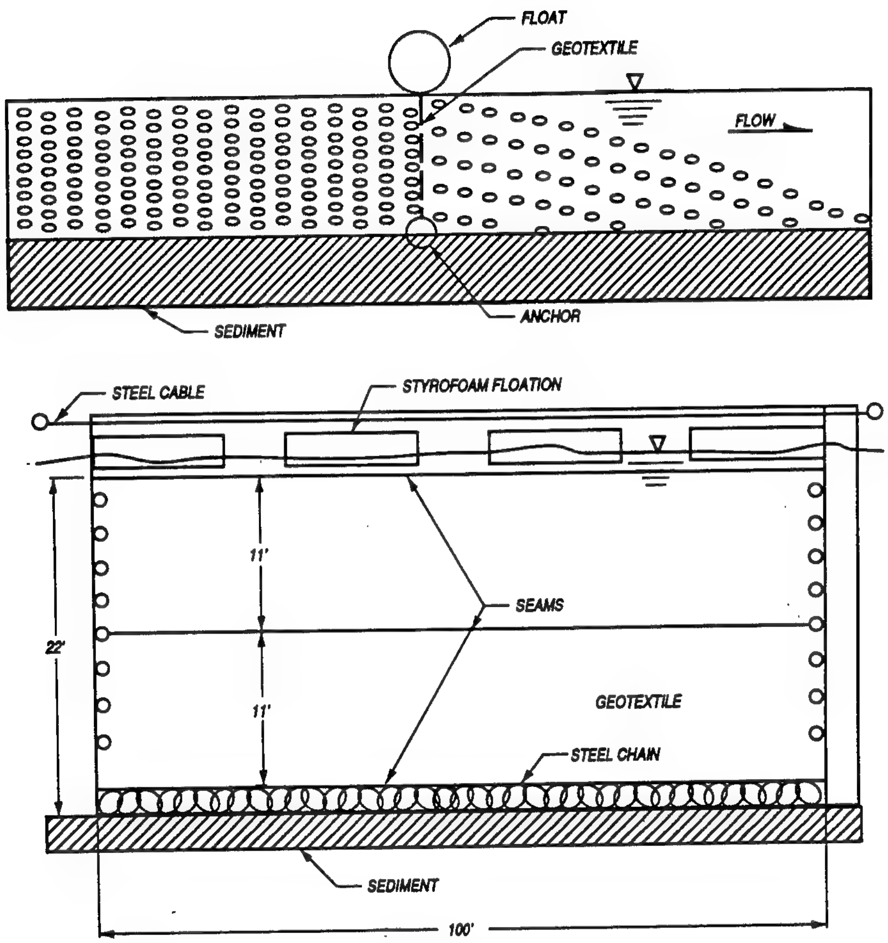


Figure 7. Sediment dispersion barrier

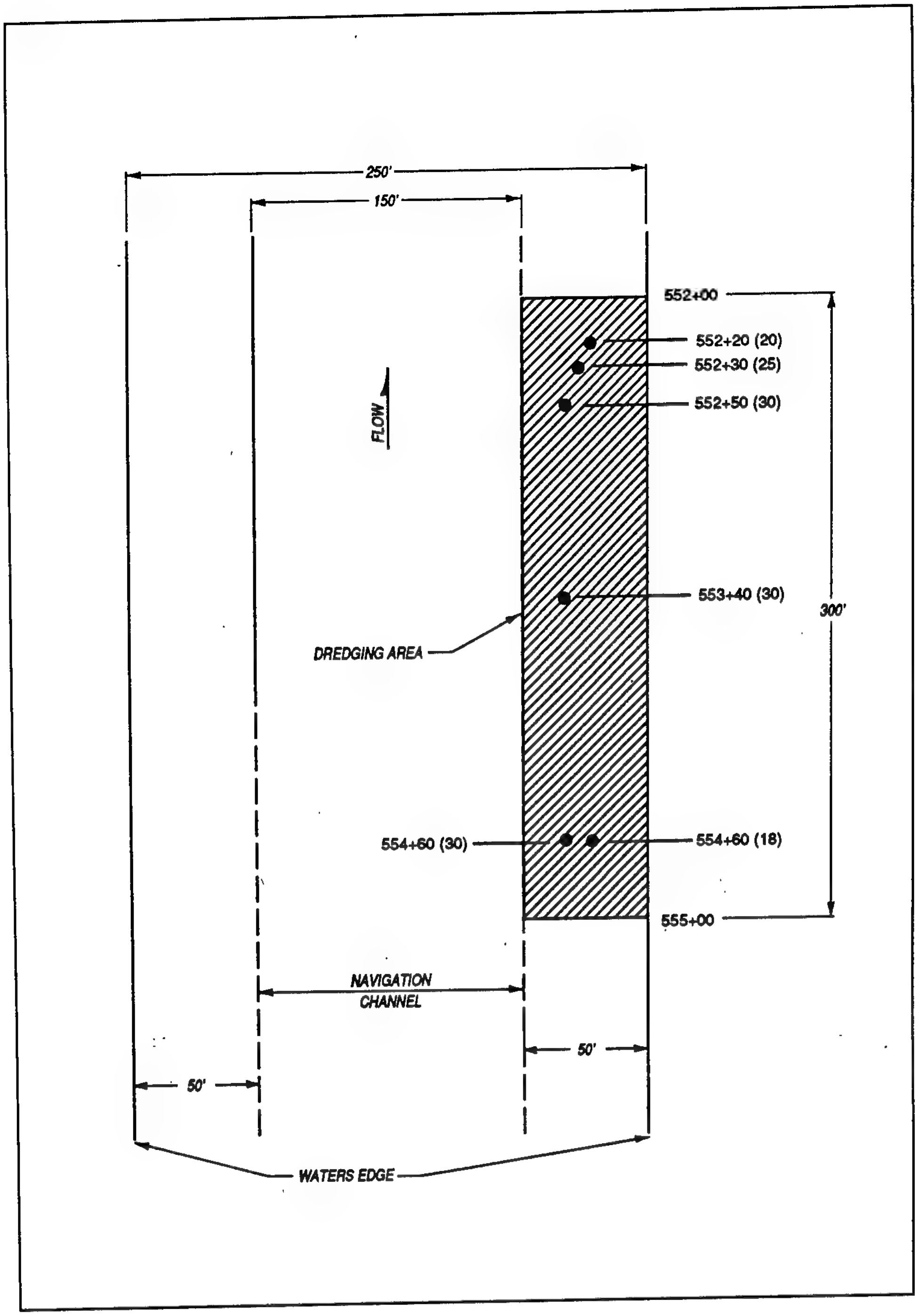


Figure 8. Pre-dredge sediment boring locations B/L Stations 552 + 00 to 555 + 00 (Dead Man's Creek)

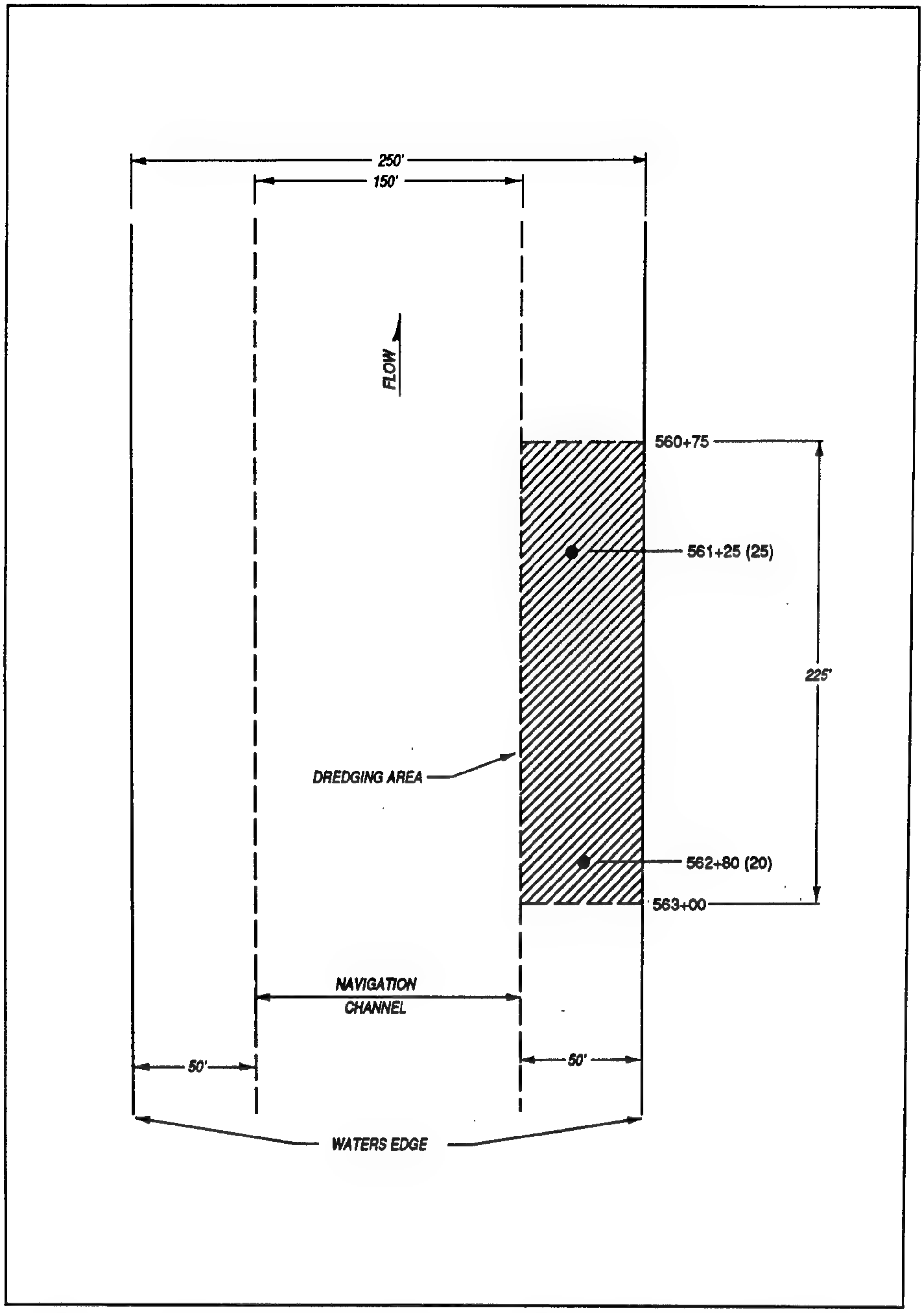


Figure 9. Pre-dredge sediment boring locations B/L Stations 560+75 to 563+00 (Dead Man's Creek)

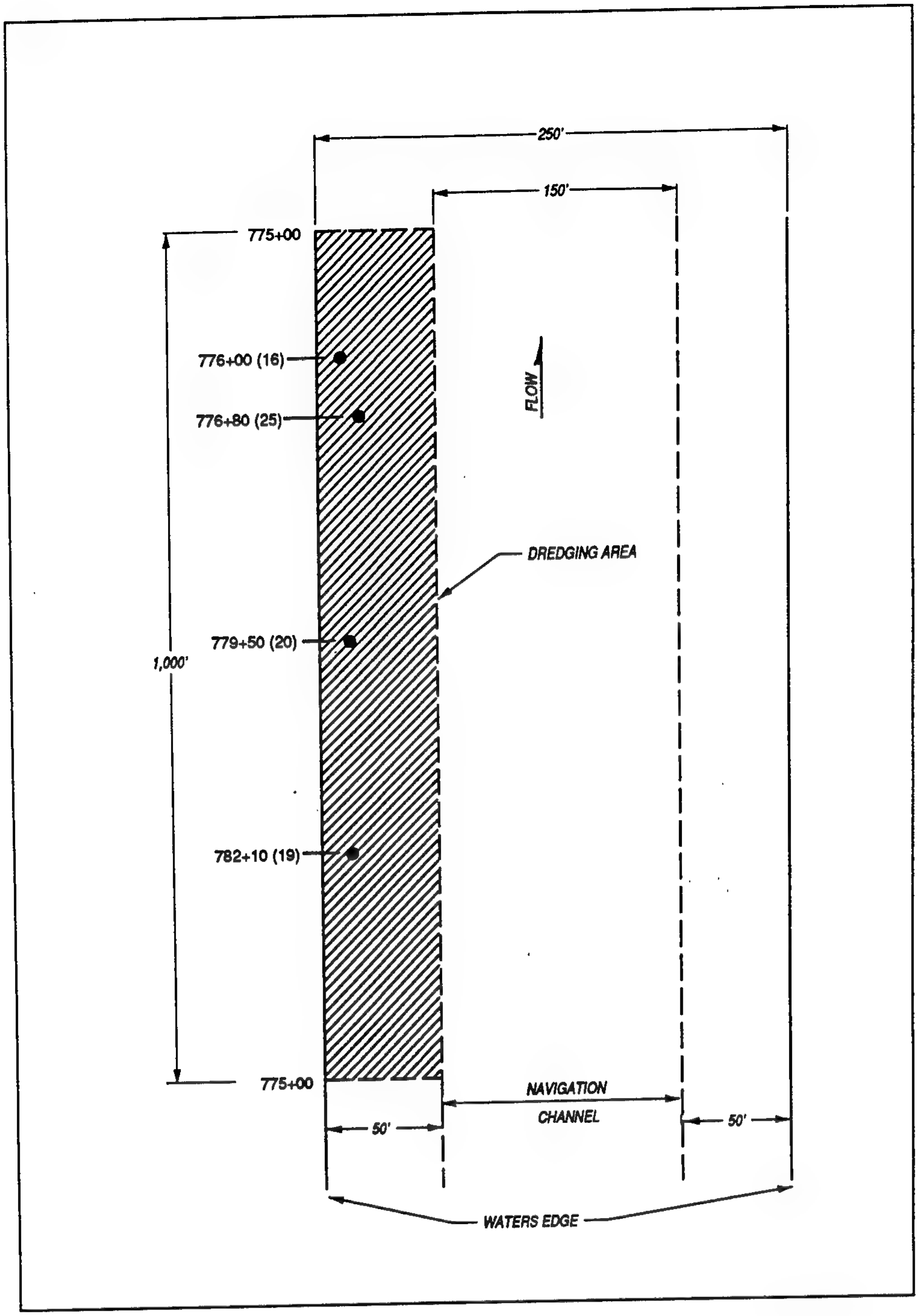


Figure 10. Pre-dredge sediment boring locations B/L Stations 775 + 00 to 785 + 00 (Mobil Oil Refinery)

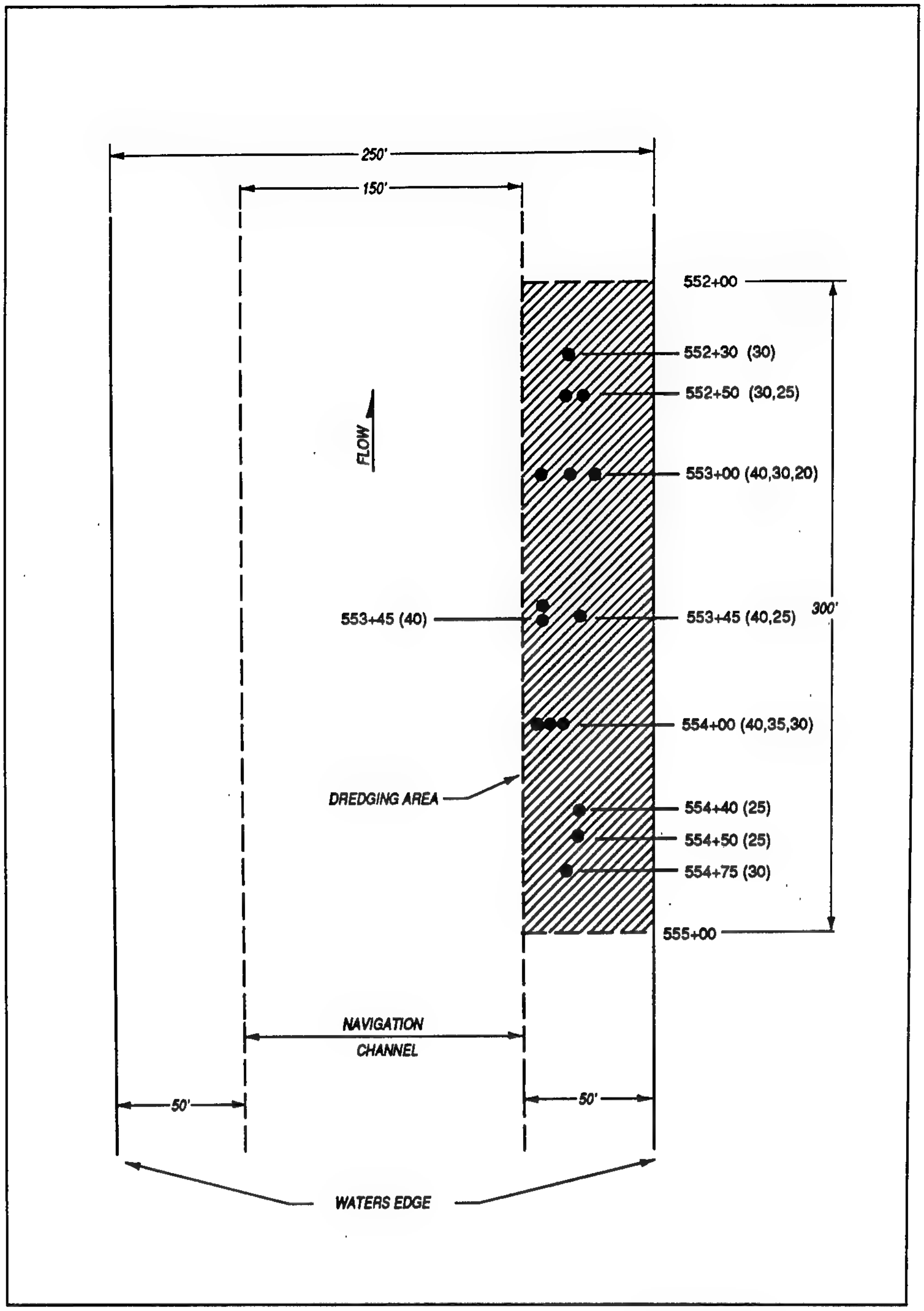


Figure 11. Post-dredge sediment grab sample locations B/L Stations 552+00 to 555+00 (Dead Man's Creek)

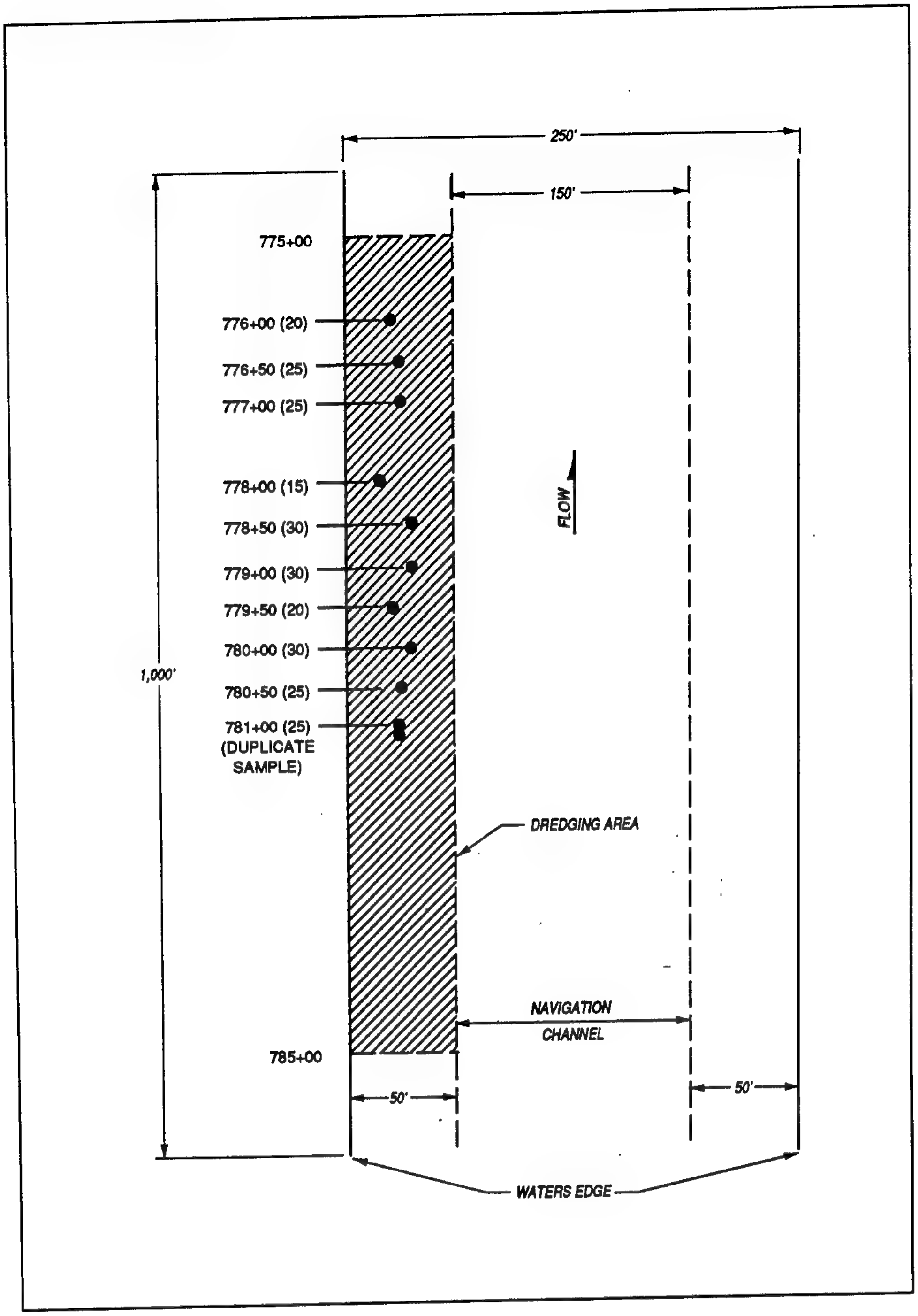


Figure 12. Post-dredge sediment grab sample locations B/L Stations 775+00 to 785+00 (Mobil Oil Refinery)

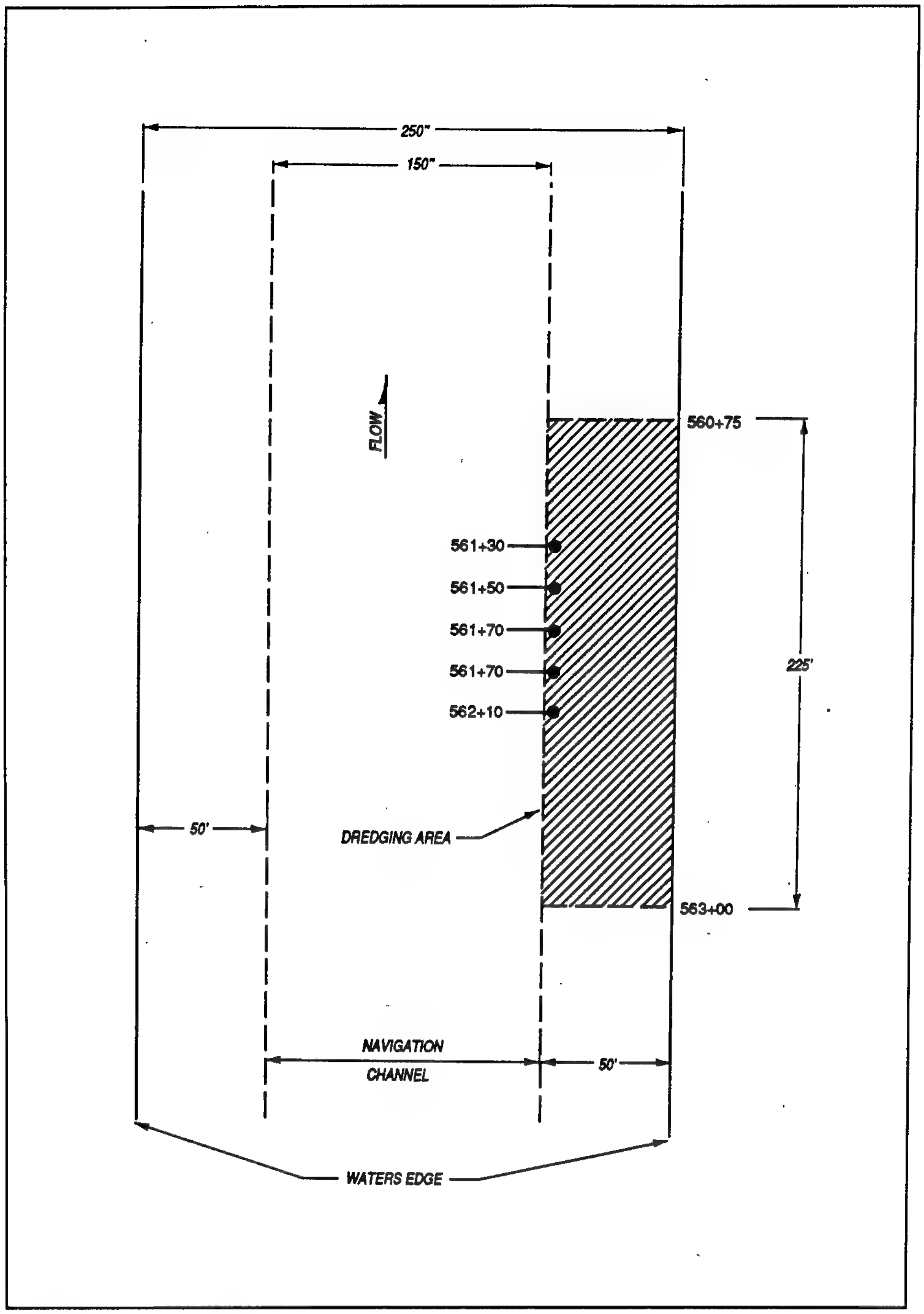


Figure 13. Post-dredge sediment grab sample locations B/L Stations 560+75 to 563+00 (Dead Man's Creek)

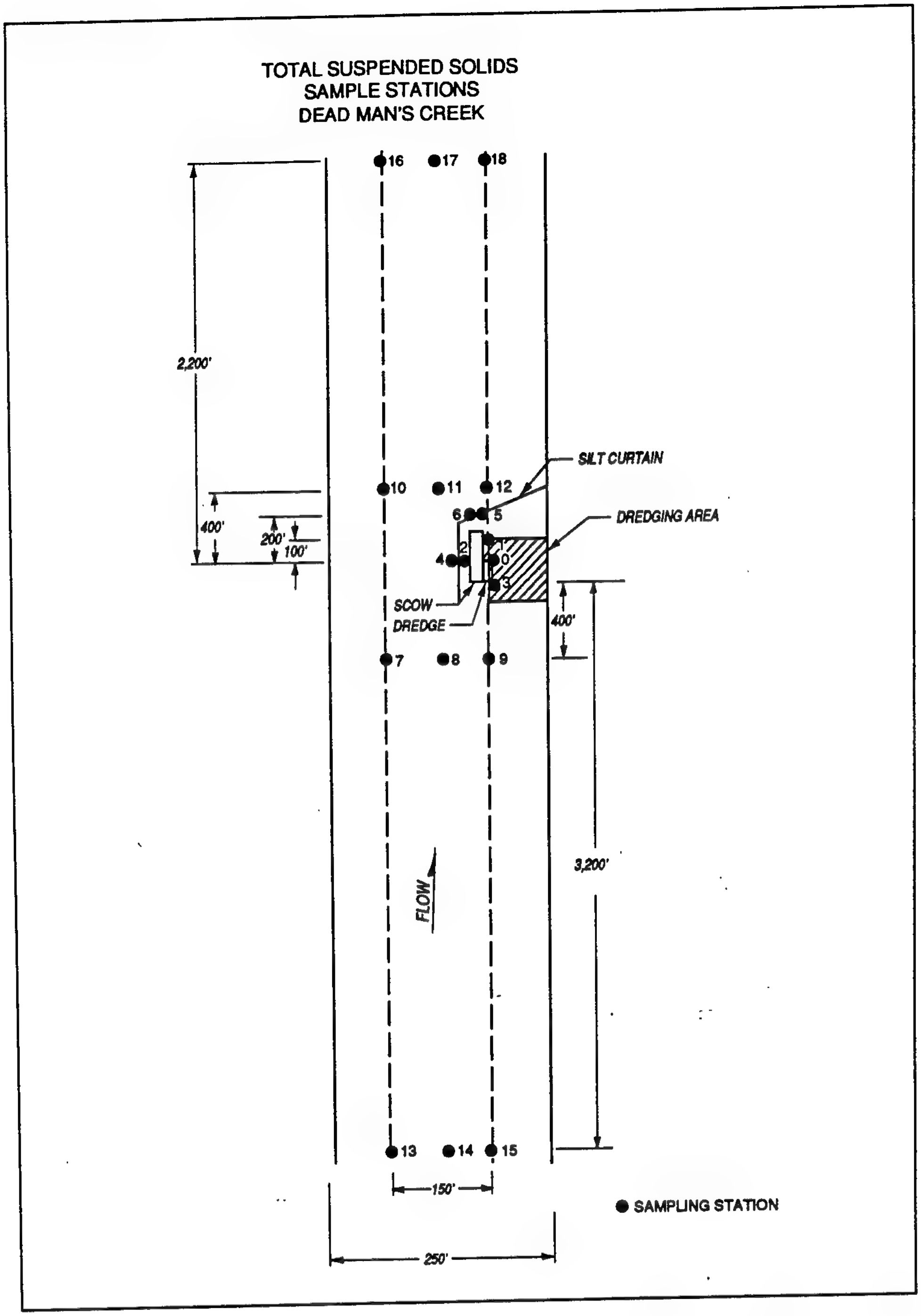


Figure 14. Water column sampling stations locations B/L Stations 552+00 to 555+00 (Dead Man's Creek)

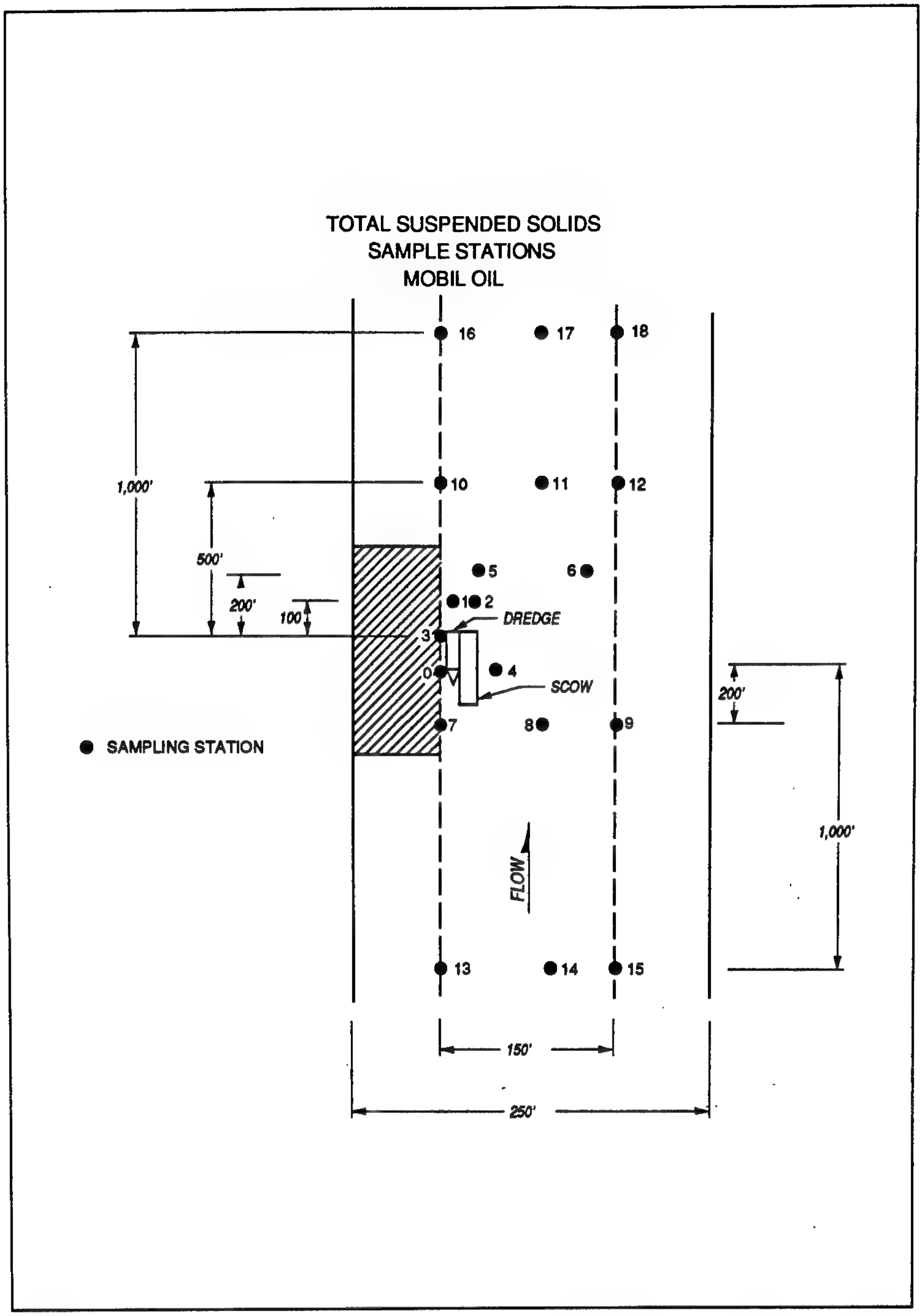


Figure 15. Water column sampling stations locations B/L Stations 775 + 00 to 785 + 00 (Mobil Oil Refinery)

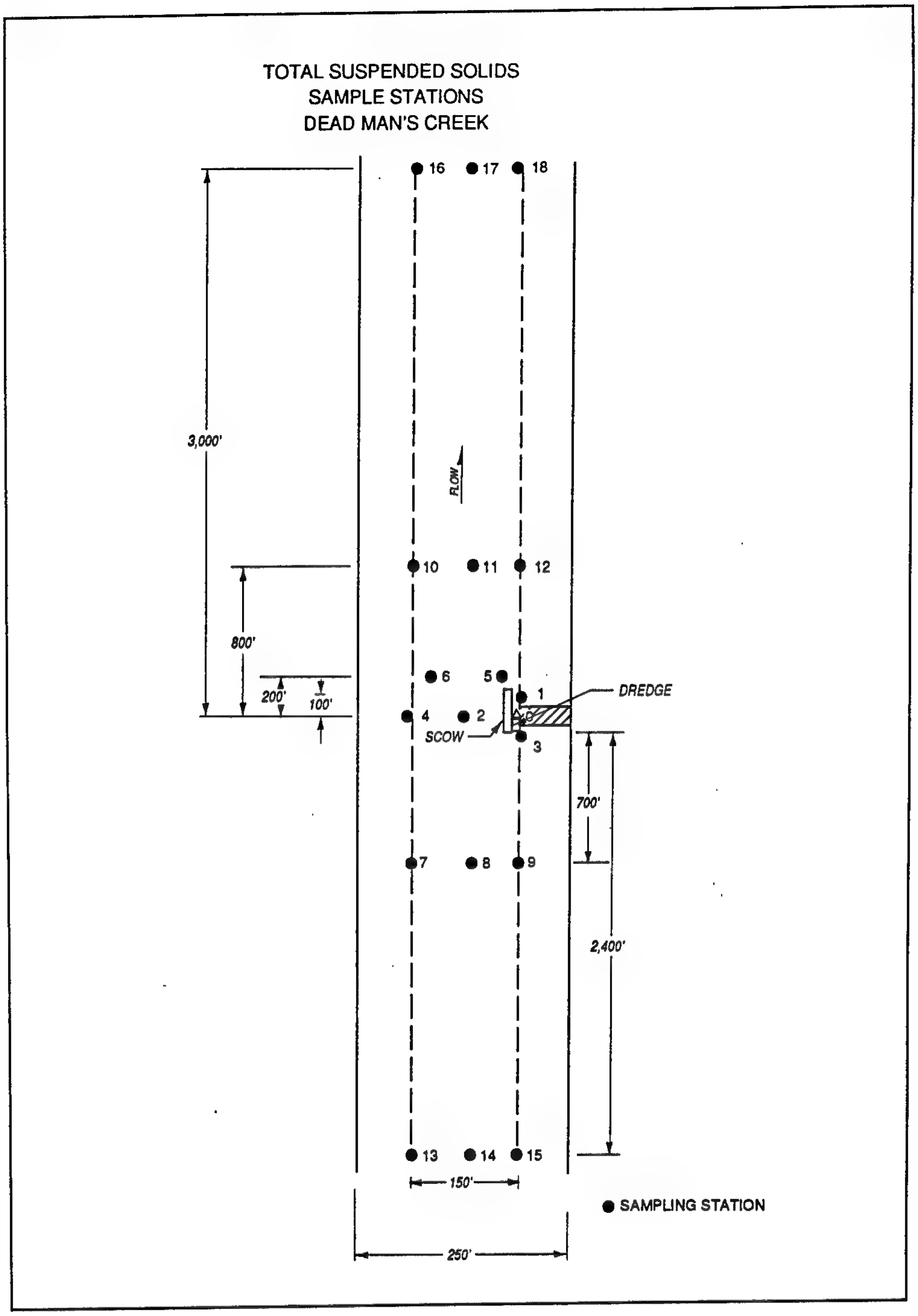


Figure 16. Water column sampling stations locations B/L Stations 560+75 to 563+00 (Dead Man's Creek)

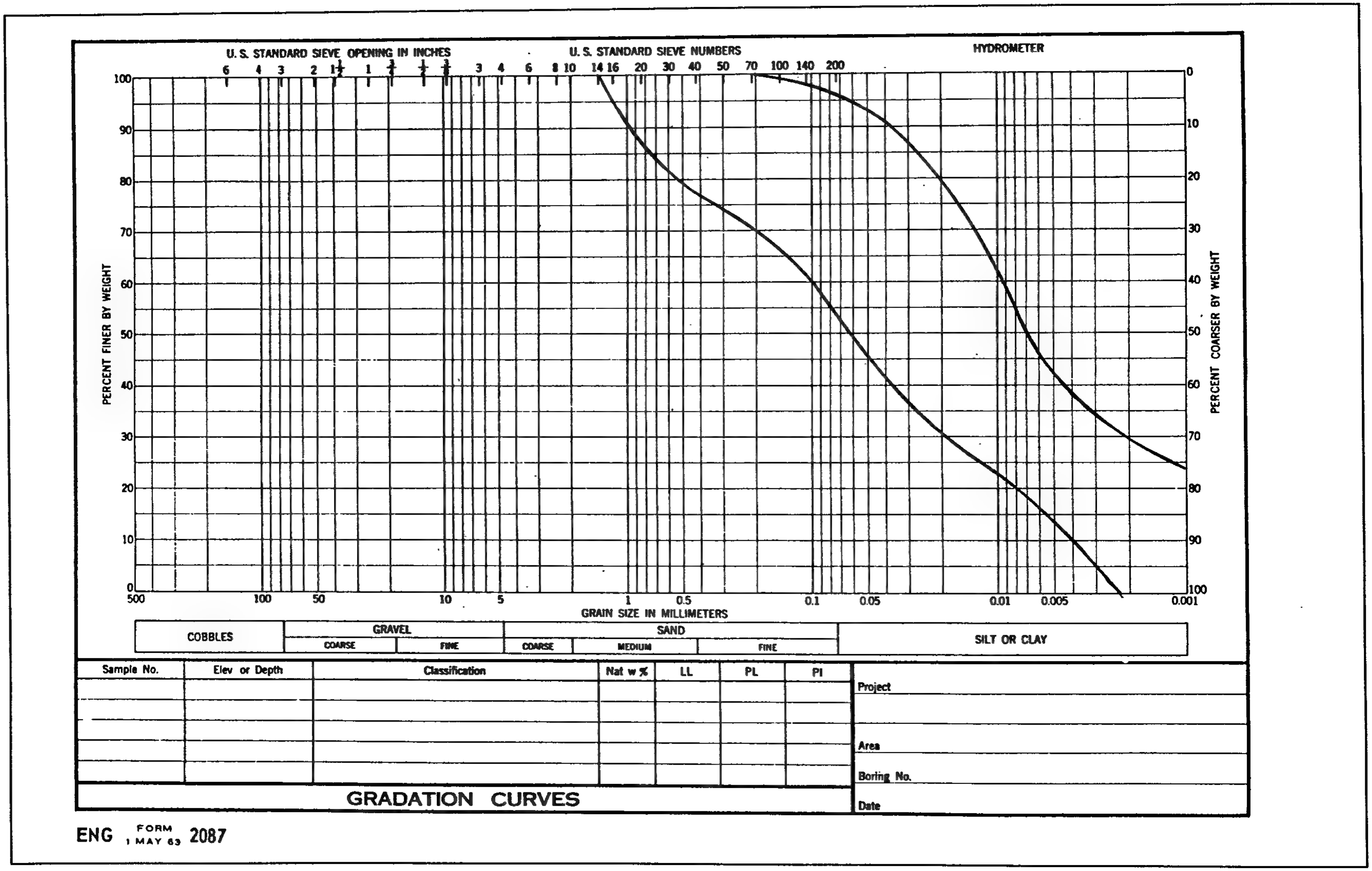


Figure 17. Pre-dredge sediment boring particle size range, B/L Stations 552+00 to 555+00 (Dead Man's Creek)

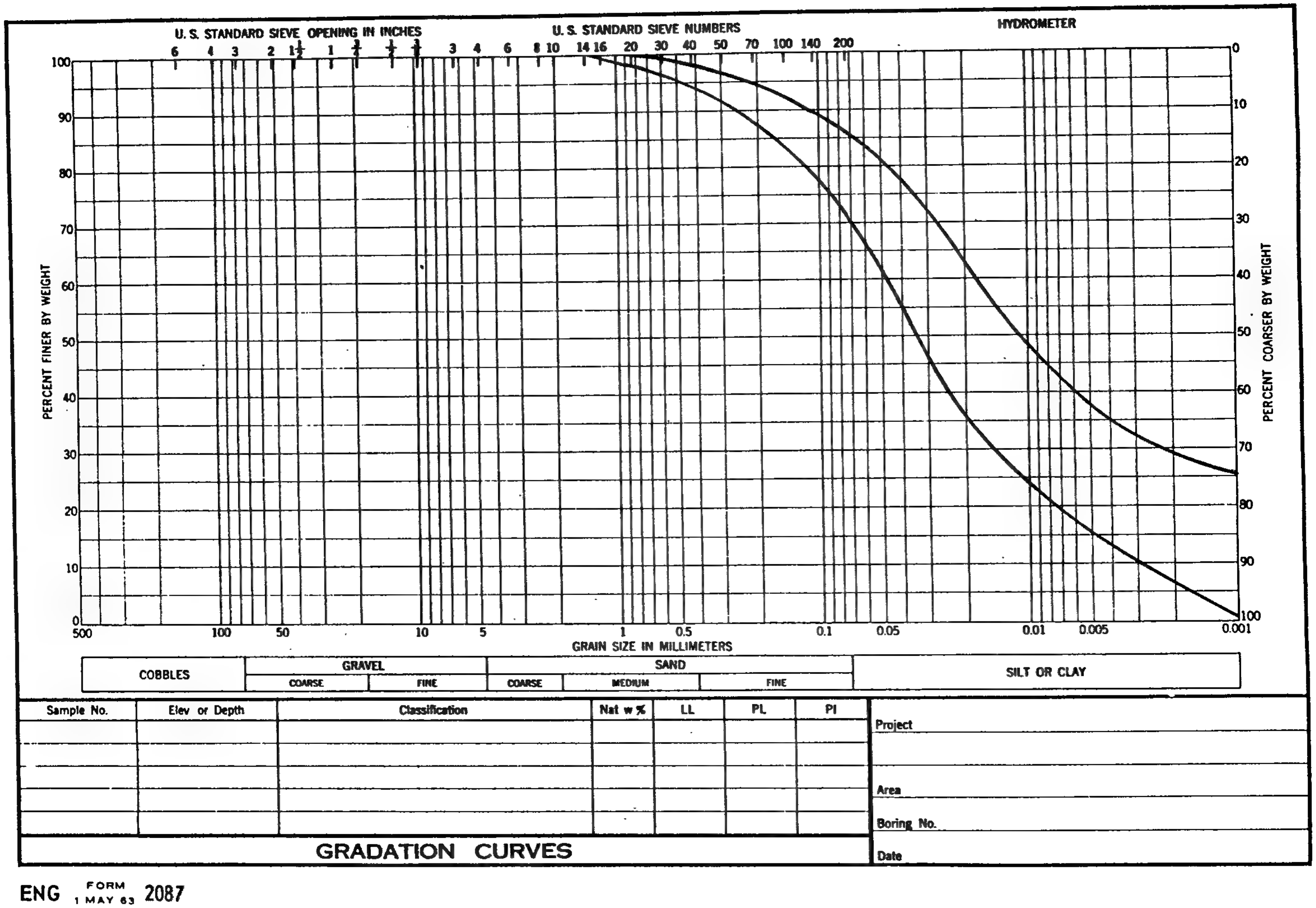


Figure 18. Pre-dredge sediment boring particle size range B/L Stations 560+75 to 563+00 (Dead Man's Creek)

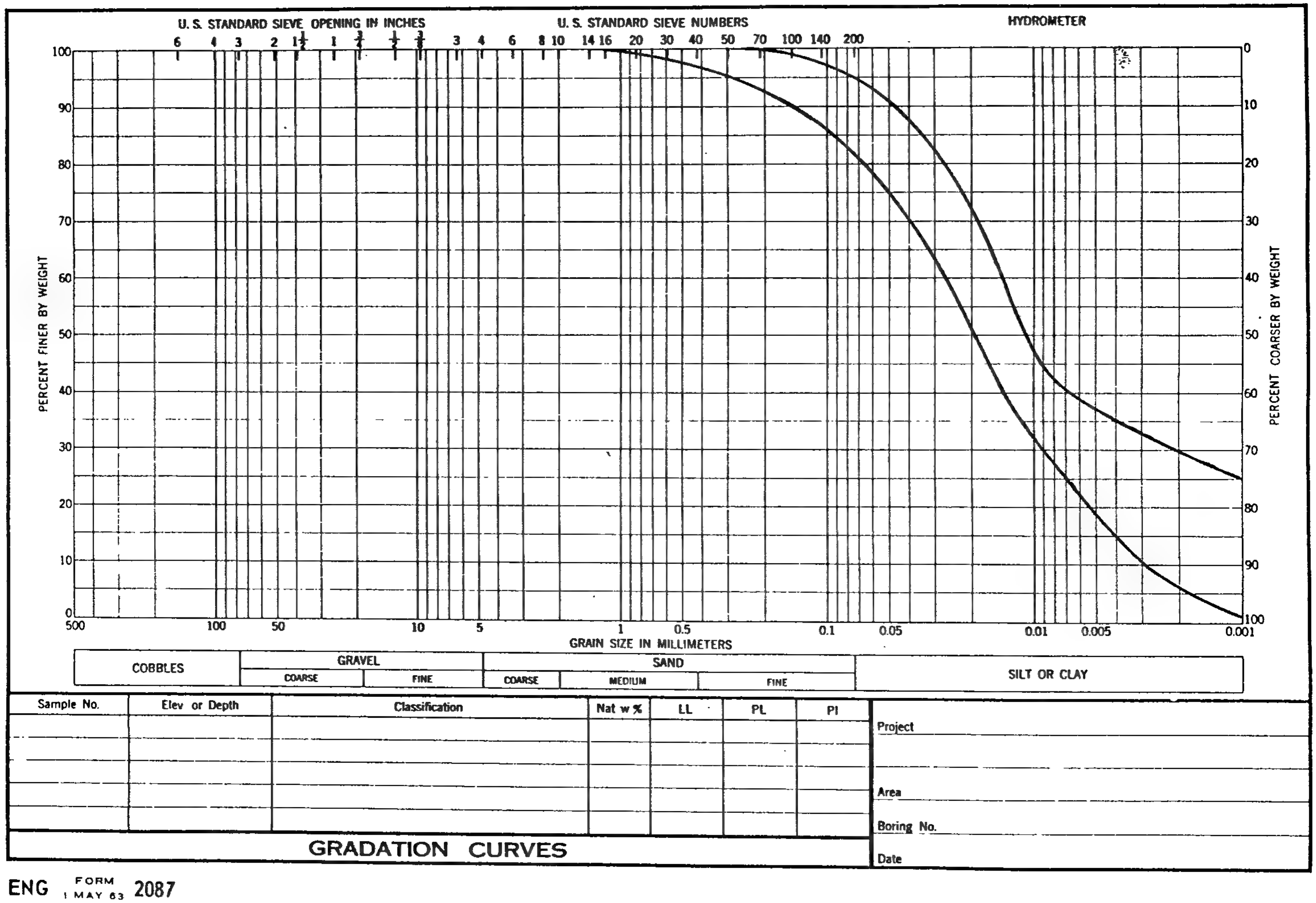


Figure 19. Pre-dredge sediment boring particle size range, B/L Stations 775+00 to 785+00 (Mobil Oil)

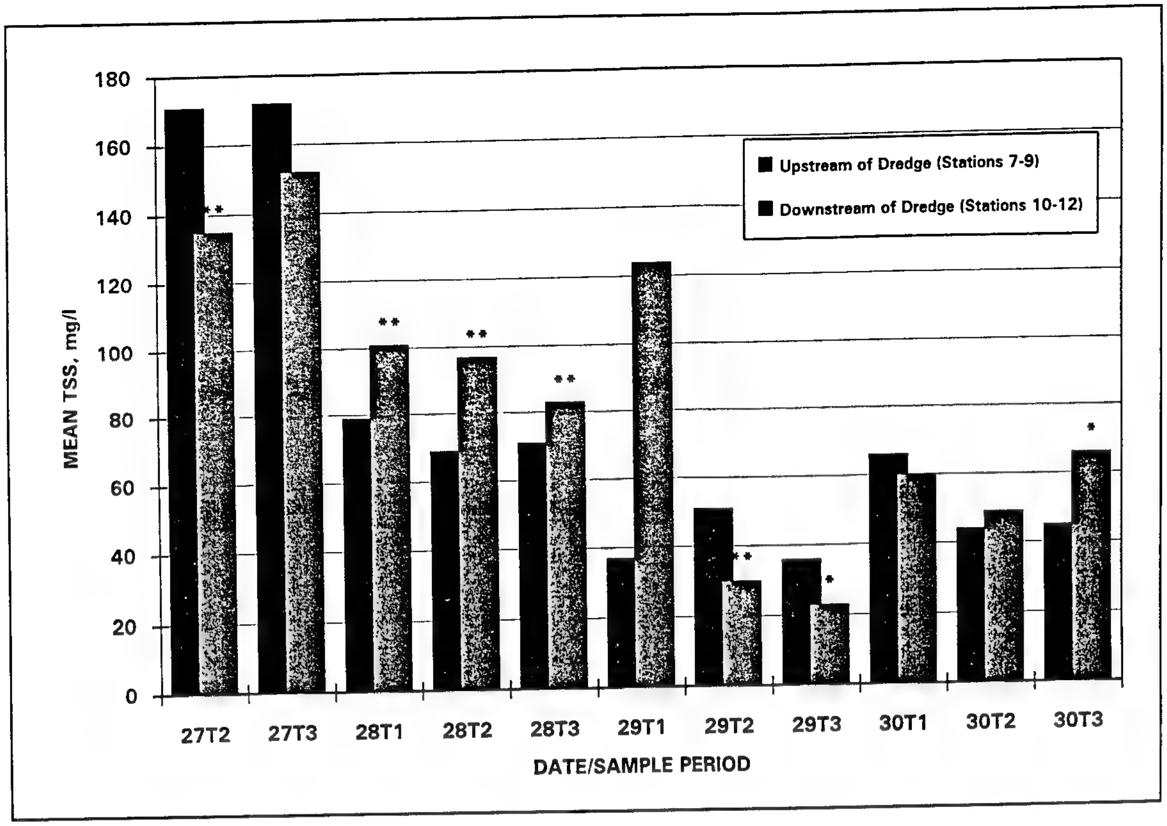


Figure 20. Water column TSS concentrations upstream (Stations 7-9) and downstream (Stations 10-12) for open bucket dredging

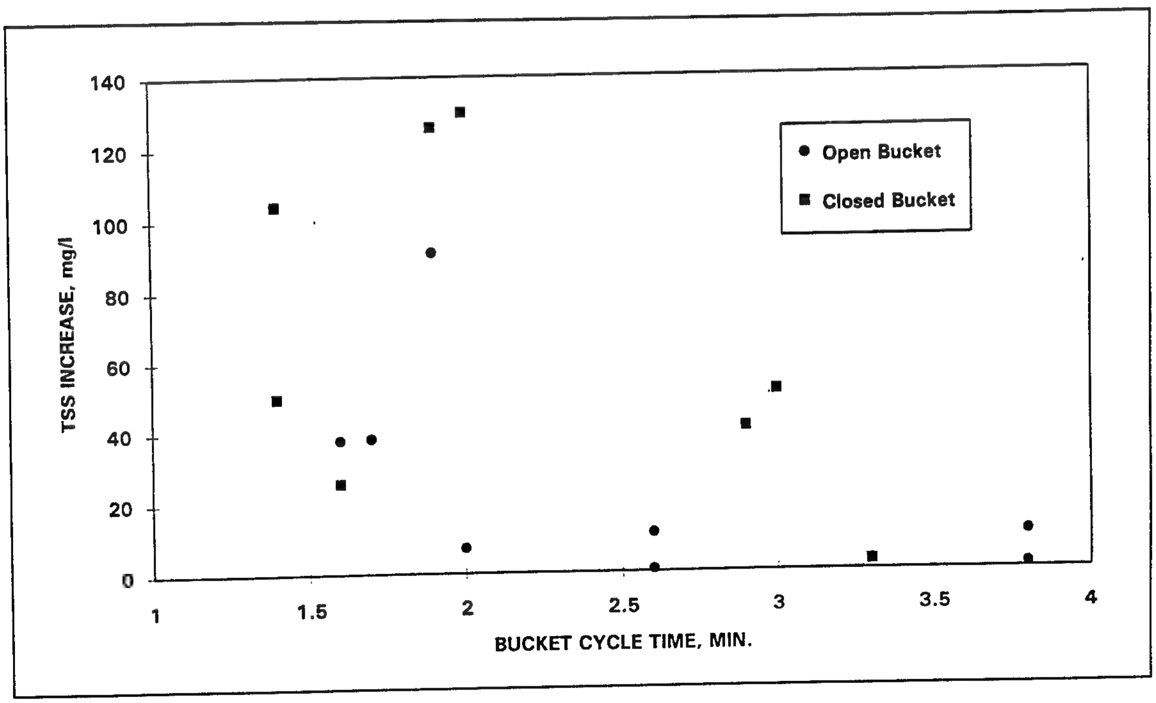


Figure 21. Near-field TSS increase due to opened and closed bucket dredging as a function of bucket cycle time

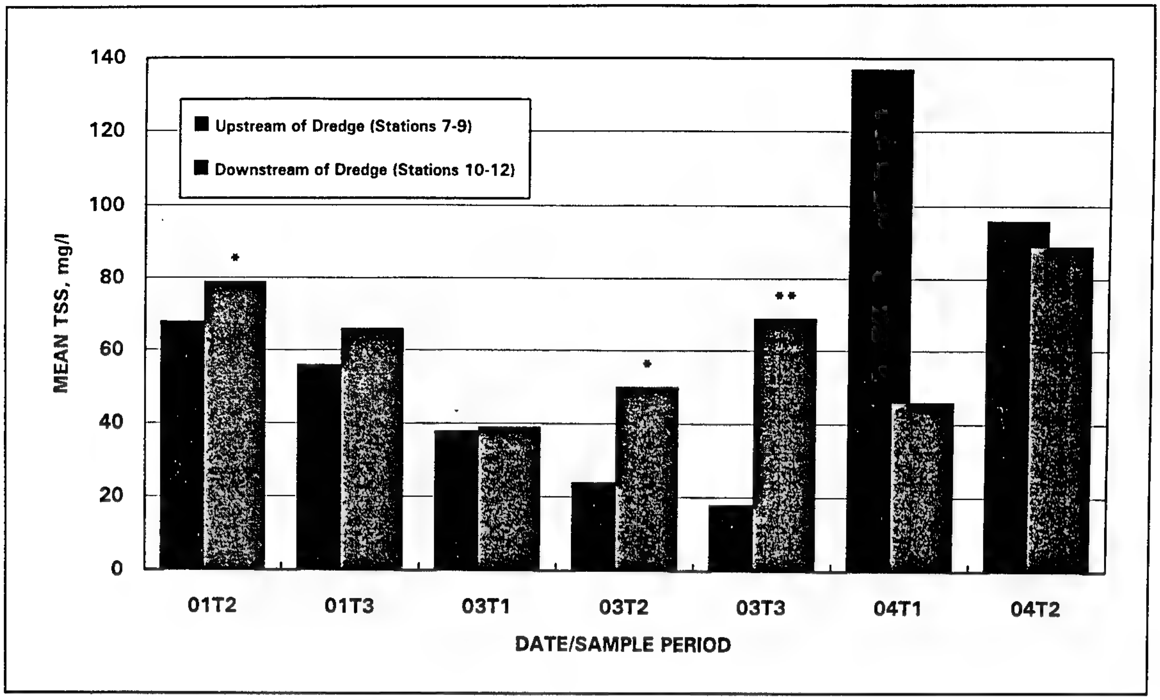


Figure 22. Water column TSS concentrations upstream (Stations 7-9) and downstream (Stations 10-12) for closed bucket dredging

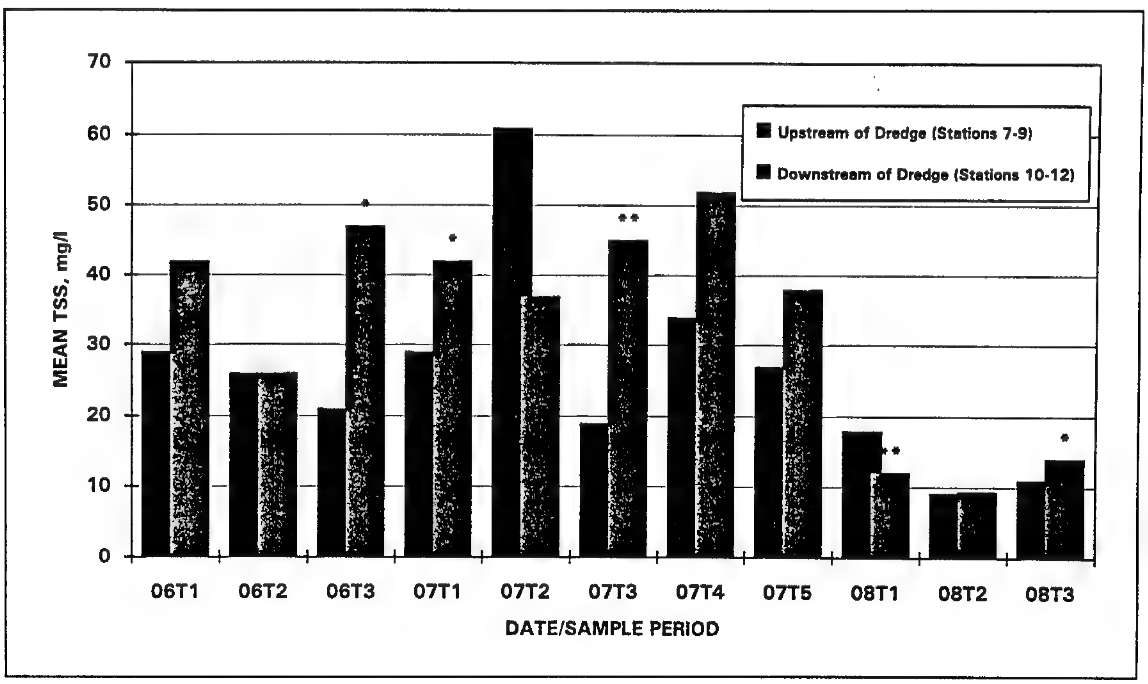


Figure 23. Water column TSS concentrations upstream (Stations 7-9) and downstream (Stations 10-12) for submersible pump dredging

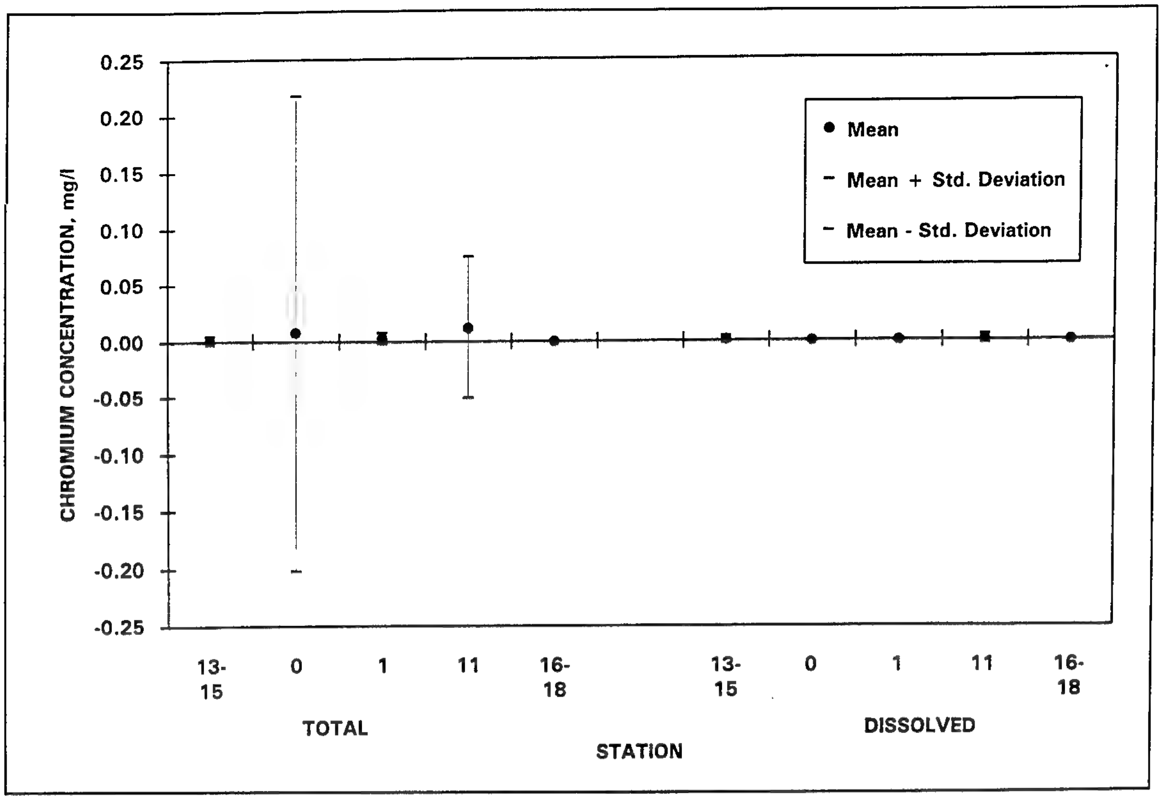


Figure 24. Water column chromium concentrations, total and dissolved, upstream to downstream stations

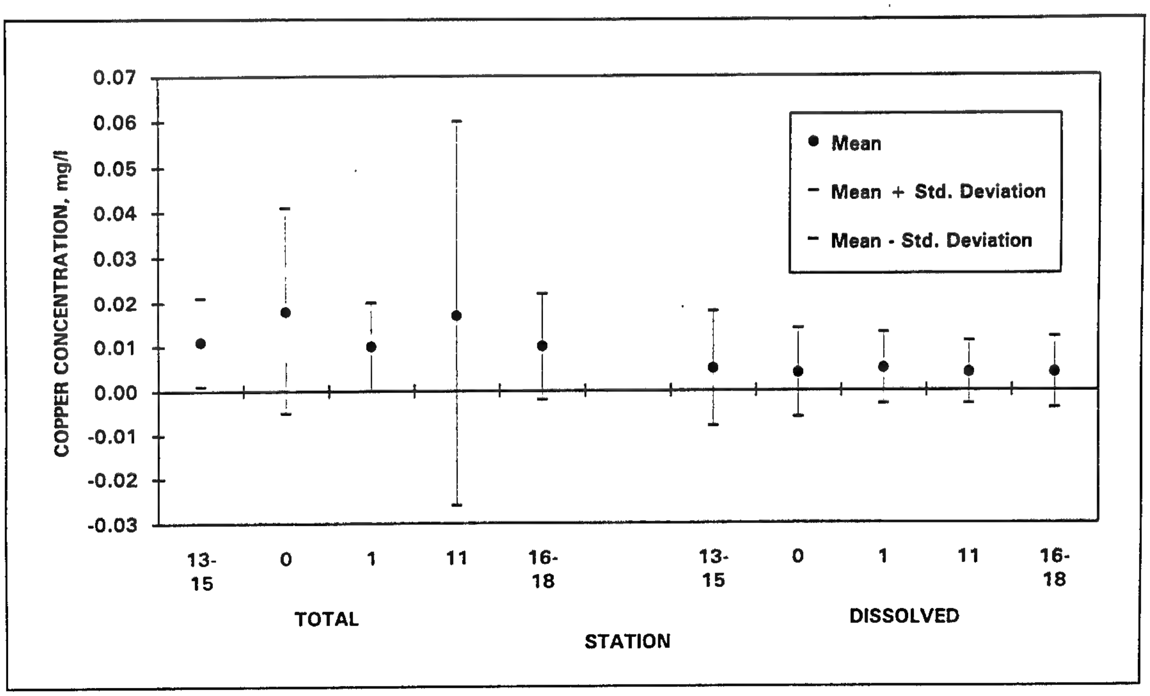


Figure 25. Water column copper concentrations, total and dissolved, upstream to downstream stations

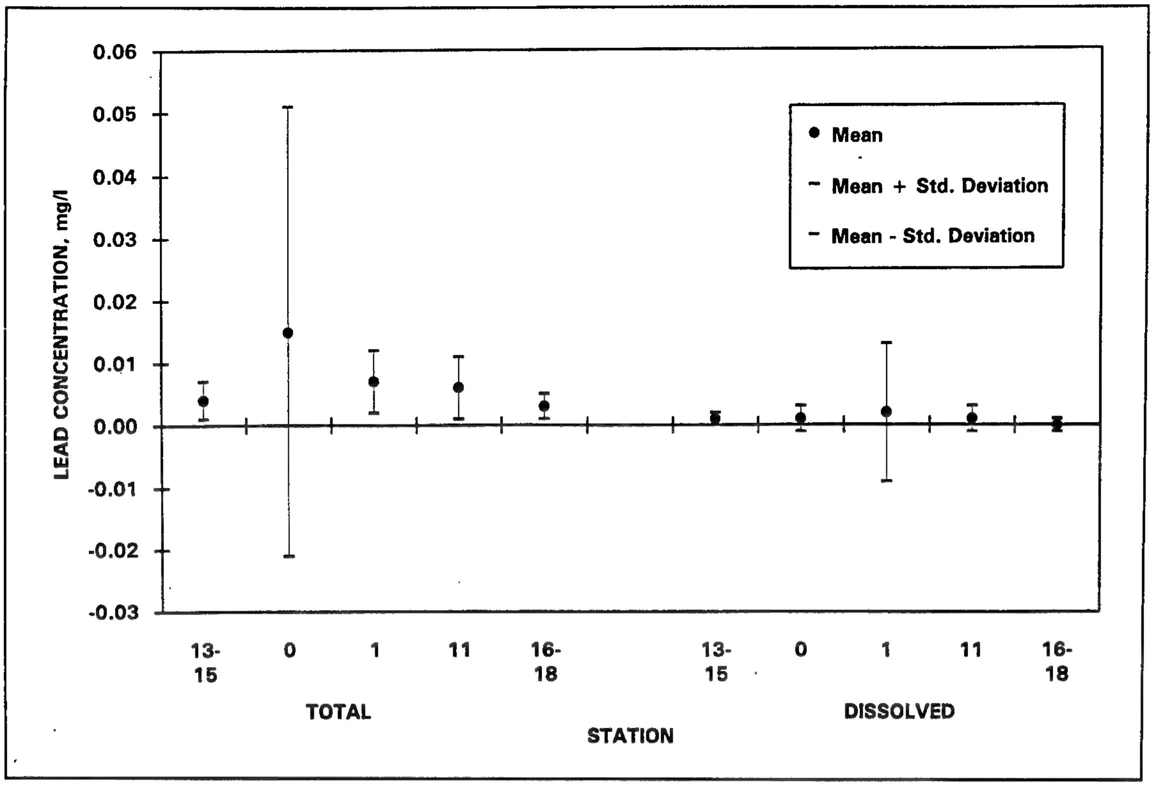


Figure 26. Water column lead concentrations, total and dissolved, upstream to downstream distances from dredge

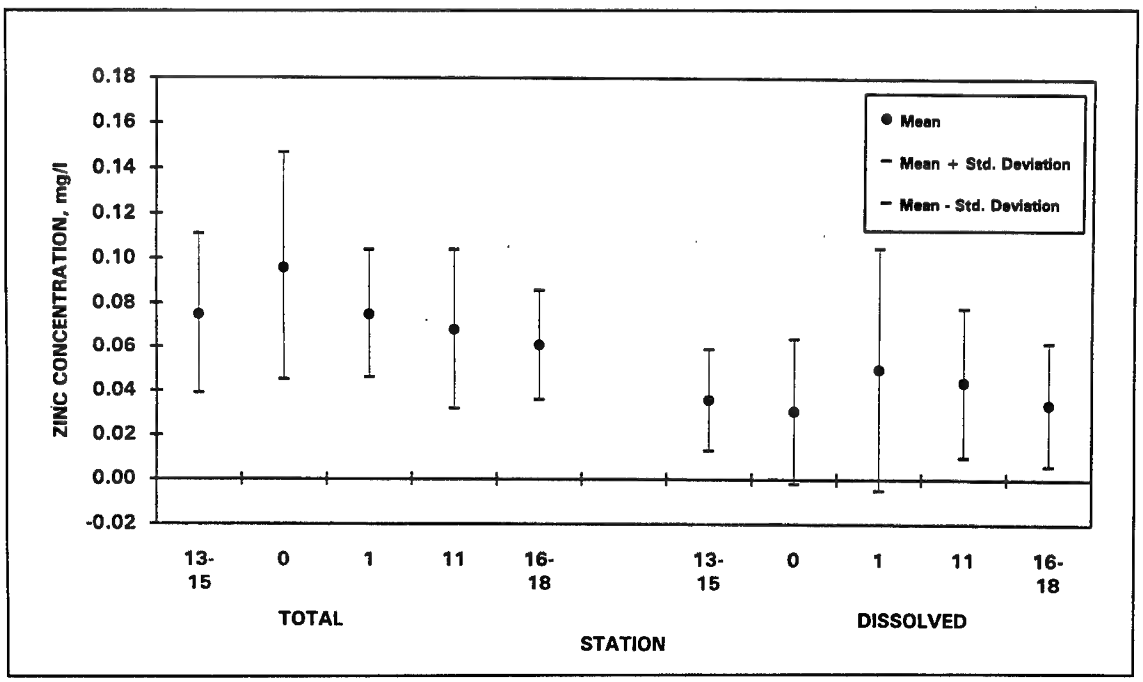


Figure 27. Water column zinc concentrations, total and dissolved, upstream to downstream distances from the dredge

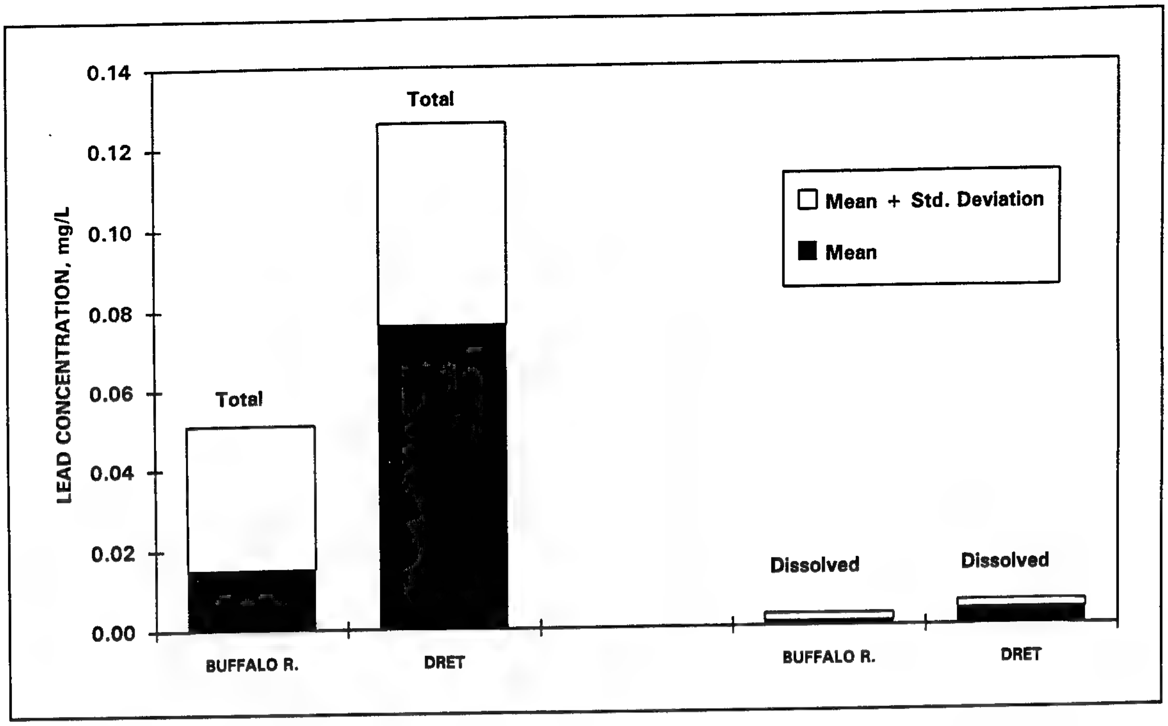


Figure 28. Lead concentrations in Buffalo River water column during dredging compared to dredging elutriate test

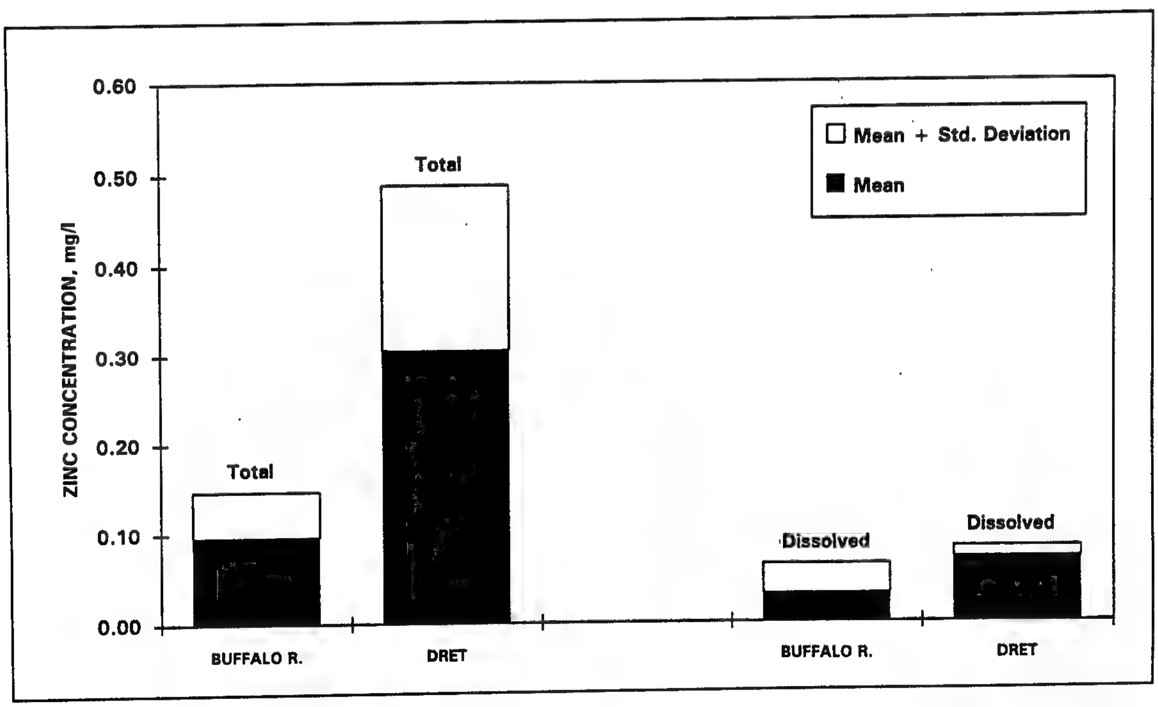


Figure 29. Zinc concentrations in Buffalo River water column during dredging compared to dredging elutriate test

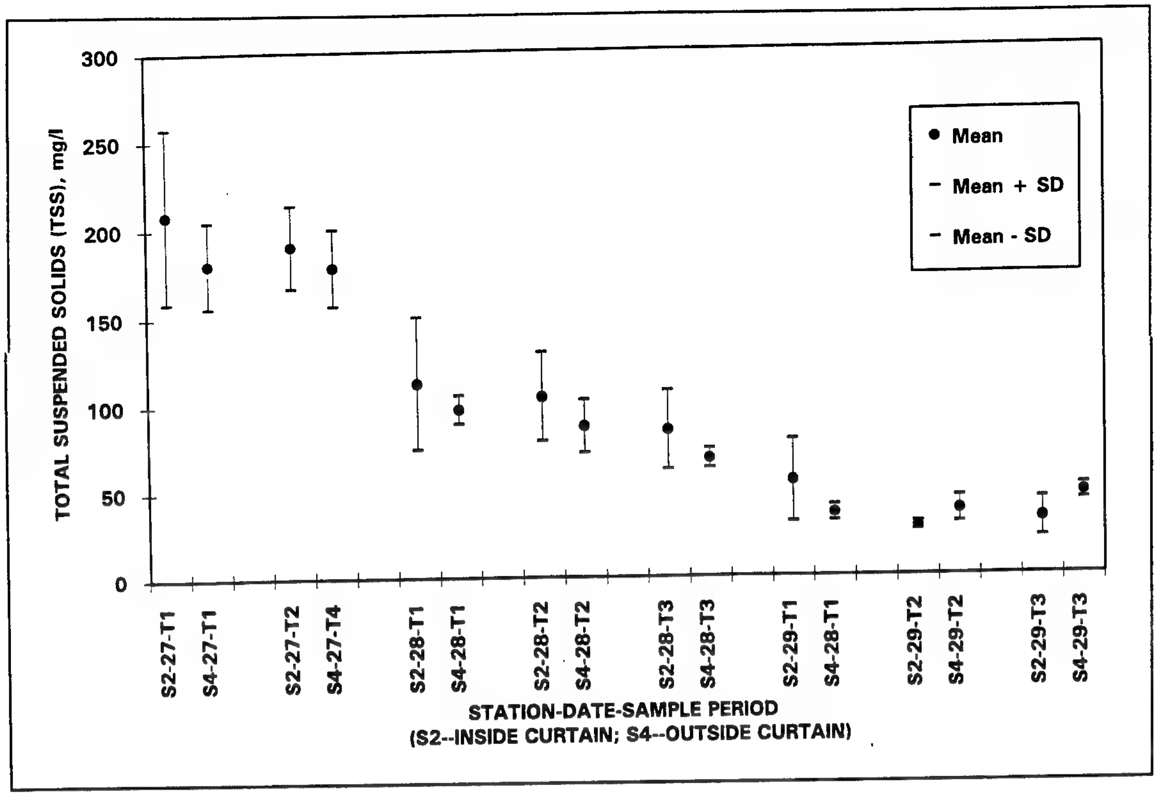


Figure 30. Effect of silt curtain on water column TSS at Stations 2 and 4 (sample 52 taken inside silt curtain; sample 54 taken outside of silt curtain)

Table 1
Methods for Analysis of Samples

Test Parameter	Water: Method EPA-600/4-79-020 or SW-846	Water: Method Detection Limit, $\mu g/\ell$	Sediment: Method (SW-846 or as noted)	Sediment: Method Detection Limit, $\mu g/g$
pH	EPA 150.1	N/A	9045	N/A
Suspended solids	EPA 160.2	5000	N/A	N/A
Moisture content	N/A	N/A	ASTM D2216	0.1
Chromium	EPA 200.7[1]	7	3050/6010	0.7
Copper	EPA 200.7[1]	6	3050/6010	0.6
Lead	EPA 239.2[1]	1	3050/7421	0.1
Zinc	EPA 200.7[1]	2	3050/6010	0.8
Nitrogen ammonia	EPA 350.3	30	N/A	N/A
Dissolved oxygen (DO)	EPA 360.1	0.1	N/A	N/A
Total organic carbon (TOC)	EPA 415.1[1]	1000	9060	10
PCBs	EPA 608[2]	0.001	3540/8080	0.2
Grain size	N/A	N/A	ASTM D421/D422	N/A
Atterberg limits	N/A	N/A	ASTM D4318	N/A

[1] These water samples will be analyzed for total and dissolved fraction. All whole water samples for heavy metals will be acid digested prior to analysis.
[2] Low-level PCBs and PAHs analyzed for dissolved and particulate fractions by Buffalo State College.

Table 2
Buffalo River Dredging Demonstration Weather Summary[1]

Date	"Character of Day"	Average Temperature, °F	Precipitation, inches
27 July	Breezy	65	0.00[2]
28	Cool	61	0.00
29	Clouds	67	0.20
30	Pleasant	63	0.02
31	Wretched	56	1.47
1 August	Terrific	63	Trace
2	Spectacular	69	0.00
3	Muggy	69	0.16
4	Unsettled	62	0.29
5	Nice	64	0.00
6	Summer	67	0.00
7	Great	70	0.00
8	Humid	72	0.30

[1] From *Buffalo News* July and August Weather Summaries (8 August and 12 September 1992 issues).
[2] 0.31 in. of precipitation fell on 26 July 1992.

Table 3
Comparison of Sediment Metal Concentrations for Three Dredging Sites

	Mean Concentrations, mg/kg			
	Cr	Cu	Pb	Zn
Deadman's Creek - Downstream	111	119	139	499
Deadman's Creek - Upstream	110	100	160	444
Mobil Oil	67	79	71	194

Table 4
Summary of Improvement of Operation and Maintenance Techniques (IOMT) Program Bucket Dredge Field Studies

IOMT Study	Date	Sed. Type (USCS)	Water Depth, ft	Water Vel., fps	Water Sal., ppt	Bucket Type	Bucket Cycle Time min	Background TSS mg/ℓ		Contour mg/ℓ		Area of 4x Bckgrd Plume on Bot., acres
								Surf.	Bot.	Min	Max	
Calumet River	8/85	Org. Silt/Clay (OH)	27[1]	<0.18	--	10 yd^3 Open	1	10	12	20	140	3.5[2]
Black Rock Harbor Channel	5/83	Sandy Clay[3]	NA	0.2 to 0.8	18	10 yd^3 Open	0.67	45	69	80	1300	14.4[2]
Duwamish River	3/84	Sandy, Clayey Silt[4]	25	0.3 to 1.1	12 to 21	Open	NA	11	26	20	160	NA
St. Johns River	2/82	Silt (MH)	15[1]	<0.2	NA	12 yd^3 Open	NA	47	72	70	480	0.515
						13 yd^3 Closed	0.75	47	72	50	380	2.0

NA = not available.
[1] Project depth.
[2] Bucket was dragged over remaining bottom sediment to smooth.
[3] Contaminated with PCB's and petroleum products.
[4] Contaminated with heavy metals and chlorinated hydrocarbons.

Table 5
Submersible Pump Production

Date	Time Interval		Production Rate cu yd/hr[1]
	From	To	
6 August 1992	0741	0829	13.4
	0902	0958	15.5
	1125	1201	17.4
	1211	1318	13.6
	1430	1652	10.3
7 August 1992	0823	0939	13.8
	1002	1131	12.4
	1139	1200	11.5
	1212	1338	8.4
	1443	1700	7.0
8 August 1992	0843	1005	2.1
	1037	1202	5.3
	1326	1405	5.8
	1416	1551	5.3
	1608	1616	4.9

[1] Calculated assuming an in situ sediment density of 1.9 g/cm^3.

Table 6
Buffalo River Water Sample Low-Level Organic Analyses

River Location	Date	PCBs, ng/l	
		Water	Suspended
Above Mobil Oil	7/24	3.28	BDL
Above Mich. Ave. Bridge	7/24	0.63	0.71
Below Mobil Oil	7/30	0.00	0.51
Below Mobil Oil	7/31	BDL	9.91
Below Mobil Oil	8/03	0.23	0.84
Below Mobil Oil	8/04	BDL	2.85
Field duplicate	8/04	BDL	3.18
Below Mobil Oil	8/06	0.44	0.72
Below Mobil Oil	8/07	BDL	1.60
Dead Man's Creek	8/08	BDL	0.66

PAHs, ng/l

Benzo[a]anthracene		Chrysene		Benzo[b]fluoranthene		Benzo[k]fluoranthene		Benzo[a]pyrene	
Water	Suspended	Water	Suspended	Water	Suspended	Water	Suspended	Water	Suspended
BDL	21.16	BDL	26.43	BDL	12.07	BQL	4.75	BDL	8.17
BDL	111.59	1.20	91.17	BQL	42.77	BDL	14.11	BDL	27.64
BDL	34.46	BDL	40.69	BQL	43.41	0.08	18.17	BDL	28.82
BDL	112.36	BDL	153.57	0.66	162.21	0.18	65.47	BQL	102.08
1.11	16.20	1.72	19.10	3.08	24.52	0.56	9.48	BQL	15.65
BDL	81.52	1.09	82.84	BQL	83.24	BDL	33.11	BDL	56.20
BDL	75.60	BDL	94.47	BDL	75.03	BQL	31.77	BDL	53.53
BDL	12.45	BDL	15.46	1.38	14.02	0.73	5.70	0.28	9.71
BDL	18.90	BDL	25.79	3.84	23.42	0.75	9.53	0.79	16.01
BDL	7.50	BDL	9.17	BQL	8.12	0.11	3.21	BDL	5.91

Table 7
Daphnia Magna Acute Toxicity Testing

Dredge/Site	Date	Acute Toxicity Observed in Laboratory		
		Upstream	Near Dredge	Downstream
No Dredging Dead Man's Cr.	24 July			✓(F)
Open Bucket Dead Man's Cr.	28 July	✓(F)		✓(F)
	29 July		✓(F)	
	30 July			
Closed Bucket Mobil Oil Site	31 July			
	03 August			
	04 August	✓ (UF)		✓ (UF)
Submersible Pump Mobil Oil Site	06 August			
	07 August			
Submersible Pump Dead Man's Cr.	08 August			

Note: "F" designates a filtered sample and "UF" designates an unfiltered or whole water sample. "✓" indicates survival of test animals 20 percent less than controls. Biologists observed that only the samples noted above showed acute toxicity, but that test animals did not grow and reproduce in most of the samples.

Table 8
Sediment Dispersion Barrier Textile Properties[1]

Geotextile Property	Test Procedure	Certified Test Values[2]
Grab tensile strength (machine/cross machine direction), lb	ASTM D-4632	375/260
Grab elongation (machine/cross machine direction), percent	ASTM D-4632	17/15
Trapezoidal tear (machine/cross machine direction), lb	ASTM D-4533	105/60
Puncture, lb	ASTM D-4833	150
Mullen burst strength, psi	ASTM D-3786	480
Permeability, cm/sec	ASTM D-4491	18
Apparent opening size (U.S. Standard Sieve)	ASTM D-4751	70
Open area, percent	CW-02215	4
Ultraviolet resistance, percent	ASTM D-4355 (500 hrs)	90

[1] Exxon Chemical Company geotextile style GTF 400E.
[2] Minimum average roll values.

Appendix A
Physical and Chemical Raw Data for Pre-Dredged Sediment

Table A1
Physical Data for Dead Man's Creek

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval, in.	Atterberg Limits		USCS Classification	Percent Solids	pH, mg/kg	TOC, mg/kg
				LL	PL				
6221-15	552+20	20	0-15	40.8	28.2	ML	63.8	7.4	15,300
6222-1			30-45	16.6	9.5	CL-ML	87.4	8.1	27,500
6222-2			60-78	21.5	17.0	CL-ML	80.0	8.1	30,000
6222-3	552+30	25	0-13	40.1	30.7	ML	68.2	7.5	12,400
6222-4			26-39	26.5	23.5	ML	71.5	7.4	14,200
6222-5			52-67	39.8	25.5	CL	62.4	7.3	25,200
6221-9	552+50	30	0-19	44.8	30.8	ML	60.2	7.5	22,100
6221-10			38-57	38.5	28.9	ML	65.7	7.5	22,300
6221-11			76-95	40.3	28.1	ML	66.3	7.6	18,700
6221-7	553+40	30	0-12	45.2	31.2	ML	60.3	7.2	19,800
6221-8			24-36	35.8	29.3	ML	75.2	7.6	20,000
6221-3	554+60	18	0-12	37.3	28.2	ML	59.9	7.6	14,300
6221-4			12-24	43.2	11.6	CL	60.3	7.2	19,800
6221-5			36-48	37.7	32.4	ML	66.1	7.2	21,600
6221-6			48-60	38.2	35.8	ML	63.1	6.9	24,000
6221-12	554+60	30	0-13	44.3	29.8	ML	62.2	7.4	N/A
6221-13			13-26	43.7	30.7	ML	64.5	7.6	22,100
6224-3			26-39	N/A	N/A	N/A	62.1	7.0	25,400
6221-14			39-53	41.4	31.0	ML	60.0	7.2	24,100
6222-6	564+25	25	0-18	38.8	23.5	ML	56.9	7.4	25,200
6222-7			36-54	39.6	30.7	ML	66.2	7.6	29,900
6221-1			72-88	31.7	31.1	ML	74.8	7.6	21,500
6222-16	562+80	20	0-12	38.1	31.9	ML	68.5	7.7	27,100
6224-1			12-24	N/A	N/A	N/A	63.7	7.4	39,600

Note: Date Collected: B/L Sample Station 561+25 - 27 June 1992, B/L Sample Stations 552+50, 554+60 and 562+80 - 28 June 1992, B/L Sample Stations 552+20, 552+30 and 561+25 - 29 June 1992.

Table A2
Physical Data for Mobil Oil Site

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval, in.	Atterberg Limits		USCS Classification	Percent Solids	pH, mg/kg	TOC, mg/kg
				LL	PL				
6222-8	776+00	16	0-20	41.6	37.4	ML	52.8	7.7	22,800
6222-9			40-60	39.8	30.1	ML	63.4	7.4	32,400
6222-10			80-100	32.9	28.4	ML	71.6	7.8	25,000
6222-11	776+80	25	0-20	44.2	27.6	CL	55.2	7.3	22,900
6224-2			40-60	N/A	N/A	N/A	62.1	7.7	25,300
6222-12			80-89	37.8	23.1	ML	74.7	7.3	25,700
6222-13	779+50	20	0-12	42.2	37.2	ML	54.5	7.5	17,900
6222-14			24-36	43.4	35.4	ML	62.3	7.6	30,000
6222-15			48-60	43.8	36.6	ML	64.7	7.3	18,700
6221-2	782+10	19	0-18	44.2	36.8	ML	58.9	7.8	22,200

Note: Date Collected: B/L Sample Station 776+00 to Station 779+50 - 27 June 1992, B/L Sample Station 782 + 10 - 29 June 1992.

Table A3
Metal Levels for Dead Man's Creek

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval in.	Metals, mg/kg													
				Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Sodium	Zinc
6221-15	552+20	20	0-15	2.7	81	1.6	49.3	63.9	27,100	83.3	335	0.52	27.1	<0.91	<1.4	1,760	231
6222-1			30-45	1.2	33.1	<0.38	11.9	14.7	7,280	15.1	167	0.17	4	<0.33	<0.75	495	57.8
6222-2			60-78	2.4	37.5	<0.54	16.3	19.8	10,800	10.8	306	0.18	6.5	<0.33	<1.1	704	53.1
6222-3	552+30	25	0-13	24.1	82.9	2.4	115	110	30,100	182	308	2.9	29.6	0.91	<1.4	1,800	453
6222-4			26-39	16.6	66	2.6	120	133	23,300	152	241	2.3	24.3	0.66	<1.2	1,380	549
6222-5			52-67	26.5	85.1	2.2	224	185	34,900	200	291	5.6	359	1.1	<1.2	2,030	929
6221-9	552+50	30	0-19	7.7	111	<0.63	45.1	55.9	32,800	62.5	450	0.54	33.2	<0.82	<1.1	556	218
6221-10			38-57	11.6	73.4	1.3	142	157	30,400	182	337	3.4	27.5	<0.79	<1.3	1,360	529
6221-11			76-95	12.3	82.3	<0.67	19.3	28	20,400	22.1	505	2	20.7	<0.79	<1.2	629	107
6221-7	553+40	30	0-12	9.8	73.5	<0.8	25.1	36.7	22,800	31	399	0.4	20.9	<0.99	<1.4	559	134
6221-8			24-36	13.5	65.9	<0.66	150	104	24,900	121	347	2.7	21.4	<0.71	<1.2	1,130	307
6221-3	554+60	18	0-12	10.7	83.6	0.89	37.4	53.3	27,800	68.7	380	0.42	27.7	<0.95	<1	829	207
6221-4			12-24	13.4	93.5	4.9	122	127	35,000	188	386	4.5	28.6	1.3	<1.5	1,510	451
6221-5			36-48	36	67.8	<1	176	199	31,500	193	309	5.7	33.1	0.71	<1.3	2,420	983
6221-6			48-60	17	69.6	1.1	207	243	33,000	268	314	2.2	33.7	<0.84	<1.3	2,460	1,100
6221-12	554+60	30	0-13	8.7	54.6	2.9	73.6	69.3	18,900	103	187	0.91	17.3	0.67	<0.61	486	261

(Continued)

Note: Date Collected (Dead Man's Creek): B/L Sample Station 561+25 - 27 June 1992; B/L Sample Stations 552+50, 554+60, and 562+80 - 28 June 1992; B/L Sample Stations 552+20, 552+30, and 561+25 - 29 June 1992. Date Collected (Mobile Oil): B/L Sample Station 776+00 to Station 779+50 - 27 June 1992; B/L Sample Station 782+10 - 29 June 1992.

Table A3 (Concluded)

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval in.	Metals, mg/kg													
				Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Sodium	Zinc
6221-13			13-26	29.5	83.4	3.6	148	144	34,300	217	353	3.1	32	0.94	<1.2	1,030	669
6224-3			26-39	48.1	71.6	1.6	215	263	34,300	259	366	3.3	39.3	<1.5	<1.5	1,350	1,070
6221-14			39-53	6.3	73.9	1.8	211	252	34,900	279	303	7.1	36.9	0.9	<1.2	2,100	1,170
6222-6	561+25	25	0-18	7.7	107	<0.85	39.3	42.6	25,600	41,200	383	0.49	26	0.75	<1.7	1,250	158
6222-7			36-54	23.7	88.7	3.8	111	121	34,100	152	358	4.3	28.4	1.3	<1.3	1,290	410
6221-1			72-88	7	72.6	0.79	91.2	91.2	27,800	116	294	3.2	26.2	<0.69	<1.1	1,270	610
6222-16	562+80	20	0-12	7.3	88.5	1.5	44.1	56.8	29,200	79.7	341	0.74	27	0.46	<1.3	912	208
6224-1			12-24	47.7	115	4.3	265	190	55,900	293	913	4.3	36.2	<1.4	<1.5	1,120	836
Site: Mobil Oil																	
6222-8	776+00	16	0-20	15.1	148	<0.95	34.4	37.1	29,600	15.8	582	<0.13	26.3	0.69	<1.9	856	128
6222-9			40-60	17.9	113	0.8	71.9	111	29,400	85.6	468	1.1	27.5	0.37	<1.4	816	192
6222-10			80-100	39.9	69.5	1.1	95.5	94.9	26,700	104	359	2.9	26.8	0.35	<1.3	1,200	349
6222-11	776+80	25	0-20	7.4	101	<0.79	147	87.6	28,500	161	416	0.31	25.3	1.1	<1.6	1,390	305
6224-2			40-60	8.2	84.8	0.88	29.7	62	25,100	73.7	544	0.27	31.1	<1.5	<1.5	844	169
6222-12			80-98	9.9	99.8	<0.64	23.9	28.9	20,900	17.5	488	1.5	19.2	0.56	<1.3	770	108
6222-13	779+50	20	0-12	7.4	125	<0.68	29	38.1	28,700	20.2	576	<0.15	27.9	0.49	<1.4	804	130

Table A4
PAH Levels for Dead Man's Creek

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval, in.	PAH, ug/kg							
				Napthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene
6221-15	552+20	20	0-15	78 U	78 U	78 U	78 U	1,100	310	78 U	78 U
6222-1			30-45	320 U	320 U	320 U	7 J	20 J	16 J	320 U	320 U
6222-2			60-78	31 U	31 U	83	31 U	180	120	31 U	31 U
6222-3	552+30	25	0-13	74 U	74 U	370 U	74 U	1,100	760	74 U	74 U
6222-4			26-39	70 U	70 U	70 U	70 U	350 U	70 U	70 U	70 U
6222-5			52-67	80 U	80 U	80 U	800	3,500 U	80 U	80 U	80 U
6221-9	552+50	30	0-19	170	83 U	83 U	83 U	410	83 U	750	83 U
6221-10			38-57	76 U	76 U	76 U	720	4,000	2,200	380 U	76 U
6221-11			76-95	76 U	76 U	76 U	76 U	2,000	1,300	76 U	76 U
6221-7	553+40	30	0-12	83 U	83 U	83 U	83 U	530	83 U	83 U	83 U
6221-8			24-36	66U	66U	1,500	450	2,500	66 U	330 U	66 U
6221-3	554+60	18	0-12	420 U	420 U	420 U	420 U	430 J	200 J	830 J	420 U
6221-4			12-24	82 U	120	170	82 U	460	82 U	82 U	82 U
6221-5			36-48	76 U	76 U	76 U	1,400	6,400	76 U	5,000	76 U
6221-6			48-60	79 U	79 U	79 U	3,200	22,000	79 U	3,900	79 U
6221-12	554+60	30	0-13	80 U	80 U	80 U	120	720	370	80 U	80 U
6221-13			13-26	78 U	78 U	78 U	610	2,600	1,400	78 U	78 U
6224-3			26-39	40 U	40 U	40 U	2,100	40 U	40 U	18,000	30,000
6221-14			39-53	83 U	83 U	2,100	1,500	83 U	83 U	83 U	83 U
6222-6	561+25	25	0-18	88 U	88 U	88 U	45 J	390	200	88 U	88 U
6222-7			36-54	380 U	380 U	380 U	7,760 U	38,000	380 U	760	380 U

(Continued)

Note: Date Collected: B/L Sample Station 552+50 to 554+60 and 562+80 - 28 June 1992; B/L Sample Station 552+20 to 552+30 and 561+25 - 29 June 1992. U = Indicates compound was analyzed for but not detected. J = Indicates an estimated value. Tentatively identified compound or less than sample quantitation limit but greater than 0. E = Concentration exceeds the calibration range of the GC/MS instrument for that specific analysis.

Table A4 (Concluded)

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval, in.	PAH, ug/kg							
				Chrysene	B.(a) anthracene	B.(b) flouranthene	B.(k) flouranthene	B.(a) pyrene	Dib.(a,h) anthracene	B.(g,h,i) perylene	I.(1,2,3-cd) pyrene
6221-1			72-88	120 U	120 U	33J	720	2,200	44 J	1,700	120 U
6222-16	562+80	20	0-12	740 U	740 U	740 U	740 U	740 U	740 U	740 U	740 U
6224-1			12-24	39 U	39 U	39 U	530	39 U	39 U	12,000	18,000
6221-15	552+20	20	0-15	410	790	400	380	490	47 U	450	320
6222-1			30-45	12 J	16	8	12	11	17 U	11 J	9 J
6222-2			60-78	31 U	6.2	10 U	35 U	34	19 U	62	25 U
6222-3	552+30	25	0-13	350	620	24 U	230	340	44 U	420	58 U
6222-4			26-39	70 U	1,500	310	22 U	610	92 U	660	340
6222-5			52-67	80 U	1,600	410	26 U	610	48 U	790	460
6221-9	552+50	30	0-19	250	17 U	270	250	370	220	280	250
6221-10			38-57	990	15 U	460	520	820	610	930	540
6221-11			76-95	630	1,000	370	350	580	330	630	400
6221-7	553+40	30	0-12	280	17 U	300	27 U	33 U	140	120 U	300
6221-8			24-36	680	390	21 U	21 U	550	350	93 U	360
6221-3	554+60	18	0-12	390 J	410	330	310	670	280 J	400 J	320 J
6221-4			12-24	340	17 U	26 U	28	680	230	120 U	340
6221-5			36-48	460	16 U	100	49	30 U	45 U	110 U	60 U
6221-6			48-60	79 U	79 U	25 U	25 U	32 U	48 U	110 U	3,100
6221-12	554+60	30	0-13	430	800	320	280	460	330	590	330
6221-13			13-26	190	930 U	450	370	590	330	740	460
6224-3			26-39	40 U	3,300	450	13 U	780	1,400	1,500	540
6221-14			39-53	980	1,600	27 U	27 U	33 U	50 U	920	460
6222-6	561+25	25	0-18	170	18 U	280	270	410	250	270	210
6222-7			36-54	380 U	76 U	120 U	4,500	7,500	230 U	530 U	300 U
6221-1			72-88	120 U	510	20 J	39 U	49 U	73 U	320	190
6222-16	562+80	20	0-12	1,100	1,800	240 U	460	1,100	1,100 U	100 U	580 U
6224-1			12-24	1,000	2,600	270	13 U	500	23 U	1,100	400

Table A5
PAH Levels for Mobil Oil Site

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval, in.	PAH, ug/kg							
				Napthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene
6222-8	776+00	16	0-20	470 U	470 U	470 U	66 J	500	110 J	470 U	470 U
6222-9			40-60	800 U	800 U	800 U	800 U	800 U	1,900	800 U	800 U
6222-10			80-100	350 U	350 U	900	1,000	4,000	2,200	350 U	350 U
6222-11	776-80	25	0-20	900 U	900 U	900 U	900 U	900 U	900 U	900 U	900 U
6224-2			40-60	40 U	40 U	40 U	70	40 U	40 U	1,400	2,500
6222-12			80-98	330 U	330 U	520	490	2,500	970	330 U	330 U
6222-13	779+50	20	0-12	45 U	45 U	45 U	45 U	260	75	1,100	900
6222-14			24-36	800 U	800 U	800 U	800 U	800 U	800 U	800 U	800 U
6222-15			48-60	380 U	380 U	380 U	790	2,500	660	380 U	380 U
6221-2	782+10	19	0-18	84 U	84 U	220	500	1,800	84 U	2,800	42

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval, in.	PAH, ug/kg							
				Chrysene	B.(a) anthracene	B.(b) fluoranthene	B.(k) fluoranthene	B.(a) pyrene	Dib.(a,h) anthracene	B.(g,h,i) perylene	I.(1,2,3-cd) pyrene
6222-8	776+00	16	0-20	470 U	340	150 U	150 U	450	280 U	660 U	380 U
6222-9			40-60	800 U	1,800	260 U	260 U	320 U	480 U	1,100 U	640 U
6222-10			80-100	350 U	6.9 U	11 U	11 U	340	21 U	49 U	150 J
6222-11	776-80	25	0-20	240 J	180 U	230 J	210 J	320 J	540 U	1,300 U	720 U
6224-2			40-60	40 U	430	220	700	780	270	380	270
6222-12			80-98	330 U	67 U	110 U	110 U	290	200 U	470 U	78 J
6222-13	779+50	20	0-12	45 U	110	14 U	14 U	450	60	65 U	200
6222-14			24-36	700 J	1,300	90 J	140 J	130 J	480 U	240 J	29 J
6222-15			48-60	380 U	77 U	120 U	120 U	150 U	230 U	540 U	84 J
6221-2	782+10	19	0-18	550	750	180	16	160	50 U	120 U	180

Date Collected: B/L Sample Station 776+50 - 27 June 1992; B/L Sample Station 782+10 - 29 June 1992.

Table A6
WES PCB Analyses of Sediment Cores

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval, in.	PCB Aroclors, mg/kg					
				PCB-1221	PCB-1232	PCB-1242	PCB-1248	PCB-1254	PCB-1260
6221-13	554 + 60	30	13-26	<0.033	<0.033	<0.033	<0.033	0.33	<0.033
6221-6	554 + 60	18	48-60	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033
6221-8	553 + 40	30	0-12	<0.028	0.028	0.11	0.047	<0.028	<0.028
6222-3	552 + 30	25	0-13	<0.035	<0.035	<0.035	0.37	0.26	0.098
6222-9	776 + 00	16	40-60	<0.035	<0.035	<0.035	<0.035	0.22	0.049
6222-12	776 + 80	25	80-98	<0.026	<0.026	<0.026	<0.026	<0.026	<0.026
6222-15	779 + 50	20	48-60	<0.029	<0.029	<0.029	0.39	0.28	0.49

Table A7
WES PAH Analyses of Sediment Cores

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval, in.	PAH, mg/kg							
				Napthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene
6222-3	552 + 30	25	0-13	0.25 J	<0.58	0.34 J	0.74	1.8	1.2	3.5	5.2
6221-8	553 + 40	30	24-36	0.31 J	<0.48	0.53	0.83	2.9	1.7	5.3	9.0
6221-6	554 + 60	18	48-60	1.5	<1.1	1.2	3.3	9.3	3.9	10	15
6221-13	554 + 60	30	13-26	0.34 J	<0.54	0.416 J	0.83	1.9	1.3	3.0	5.1
6222-9	776 + 00	16	40-60	0.06 J	<0.51	<0.51	0.19 J	0.81	0.26 J	0.40 J	1.5
6222-12	776 + 80	25	80-98	0.14 J	<0.43	<0.43	0.09 J	0.50	0.21 J	0.30 J	1.9
6222-15	779 + 50	20	48-60	0.12 J	<0.49	<0.49	0.19 J	0.80	0.15 J	0.35 J	0.90

ARDL Number	B/L Sample Station	Distance from Shoreline, ft	Core Interval, in.	PAH, mg/kg							
				Chrysene	B.(a) anthracene	B.(b) fluoranthene	B.(k) fluoranthene	B.(a) pyrene	Dib.(a,h) anthracene	B.(g,h,i) perylene	I.(1,2,3-cd) pyrene
6222-3	552 + 30	25	0-13	1.6	1.3	0.97	0.48 J	0.70	0.35 J	<0.58	0.29 J
6221-8	553 + 40	30	24-36	2.2	2.3	1.2	0.82	1.3	0.52	0.11 J	0.50
6221-6	554 + 60	18	48-60	2.8	4.2	2.4	1.9	1.4	0.59 J	0.18 J	0.54 J
6221-13	554 + 60	30	13-26	1.7	1.4	1.2	0.56	0.91	0.50 J	0.13 J	0.43 J
6222-9	776 + 00	16	40-60	0.52	0.21 J	0.43 J	0.19 J	0.33 J	0.06 J	<0.51 J	0.12 J
6222-12	776 + 80	25	80-98	0.88	0.33 J	0.47	0.41 J	0.58	0.24 J	<0.43	0.25 J
6222-15	779 + 50	20	48-60	0.59	0.44 J	0.39 J	0.30 J	0.40 J	0.24 J	<0.49	0.20 J

Note: Date Collected: B/L Sample Station 550 + 50 to 554 + 60 and 562 + 80 - 28 June 1992; B/L Sample Station 552 + 20 to 552 + 30 and 561 + 25 - 29 June 1992.

Table A8
Pre-Dredge Sediment - Total PCB and PAH Data -- USEPA Expedient Method

Date	Baseline Station	Distance from Shore, ft	Core Interval, in. Start	End	Total PCB ug/kg	Total PAH ug/kg
6/29/92	552+20	20	0	15	5,800	155,000
			15	30	7,400	184,000
			30	45	2,700	13,000
			45	60	3,200	243,000
			60	78	2,400 (2,500)	35,000 (47,000)
6/29/92	552+30	25	0	13	23,500	429,000
			13	26	11,700	283,000
			26	39	7,100	290,000
			39	52	7,900	286,000
			52	67	8,200	391,000
6/28/92	552+50	30	0	19	3,300	43,000
			19	38	4,400	502,000
			38	57	5,200	148,000
			57	76	5,500	435,000
			76	95	7,100	281,000
6/28/92	553+40	30	0	12	7,000	63,000
			12	24	11,800	657,000
			24	36	8,500 (7,200)	495,000 (478,000)
6/28/92	554+60	18	0	12	7,300	136,000
			12	24	8,900	153,000
			24	36	9,600	117,000
			36	48	12,300	1,408,000
			48	60	12,300	957,000
6/28/92	554+60	30	0	13	10,000	176,000
			13	26	13,400 (14,300)	367,000 (369,000)
			26	39	10,100	1,740,000
			39	53	9,600	969,000

(Continued)

Table A8 (Concluded)						
Date	Baseline Station	Distance from Shore, ft	Core Interval, in.		Total PCB ug/kg	Total PAH ug/kg
			Start	End		
6/29/92	561+25	25	0	18	3,000	105,000
			18	36	4,000	173,000
			36	54	8,700	644,000
			54	72	4,100	744,000
			72	88	2,700 (2,500)	426,000 (339,000)
6/28/92	562+80	20	0	12	7,900	194,000
			12	24	12,000	462,000
			24	36	???	???
6/27/92	776+00	16	0	20	2,200	26,000
			20	40	2,900	116,000
			40	60	4,000	388,000
			60	80	2,800	400,000
			80	100	4,200	382,000
6/27/92	776+80	25	0	20	3,600	29,000
			20	40	4,200	64,000
			40	60	4,600	203,000
			60	80	2,800	263,000
			80	98	2,500 (2,500)	426,000 (413,000)
6/27/92	779+50	20	0	12	2,900	32,000
			12	24	4,100	34,000
			24	36	4,100	312,000
			36	48	4,000	119,000
			48	60	6,100	315,000
6/29/92	782+10	19	0	18	2,900	697,000

Appendix B
Summary Statistics for Pre-Dredged Sediment

Table B1
Pre-Dredged Sediment - Summary Statistics[1] B/L Stations 552+00 to 555+00 (Dead Man's Creek)

Parameter	Sample Size	Mean	Minimum Value	Maximum Value	Standard Deviation
LL, %	18	37.5	16.6	45.2	8.0
PL, %	18	26.8	9.5	35.8	7.1
Total Solids, %	19	66.3	59.9	87.4	7.5
pH, mg/kg	19	7.4	6.9	8.1	0.3
TOC, mg/kg	18	21,000	12,400	30,000	4,790
Naphthalene[1]	19	0.009	0.0	0.17	0.039
Acenaphthylene	"	0.006	0.0	0.12	0.028
Acenapthene	"	0.20	0.0	2.1	0.57
Fluorene	"	0.57	0.0	3.2	0.89
Phenanthrene	"	2.5	0.0	22	5.0
Anthracene	"	0.35	0.0	2.2	0.62
Fluoranthene	"	1.5	0.0	18	4.2
Pyrene	"	1.6	0.0	30	6.9
Chrysene	"	0.34	0.0	0.99	0.32
B. (a) Anthracene	"	0.63	0.0	3.3	0.87
B. (b) Fluoranthene	"	0.22	0.0	0.46	0.19

(Continued)

1 Summary statistics were calculated by assuming below detection values were zero (NYDEC 1989). All PCB Aroclors were below detection.
2 All PAH and metals are given in mg/kg or ppm.
3 Estimated in the field by USEPA using enzyme immunoassay techniques.
4 Estimated in the field by USEPA using fluorometric techniques.

Table B1 (Concluded)

Parameter	Sample Size	Mean	Minimum Value	Maximum Value	Standard Deviation
B. (k) Fluoranthene	"	0.146	0.0	0.52	0.18
B. (a) Pyrene	19	0.40	0.0	0.82	0.30
Dib (a,h) Anthracene	"	0.22	0.0	1.4	0.34
B (g,h,i) Perylene	"	0.44	0.0	1.5	0.42
I. (1,2,3-cd) Pyrene	"	0.45	0.0	3.1	0.67
Arsenic[1]	"	15.7	1.2	48.1	12.2
Barium	"	73.1	33.1	111.0	18.0
Cadmium	"	1.4	0.0	4.9	1.4
Chromium	"	111	11.9	224	74.8
Copper	"	119	14.7	263	80.5
Iron	"	27,100	7,280	35,000	8,180
Lead	"	139	10.8	279	88.9
Manganese	"	331	167	505	80
Mercury	"	2.52	0.17	7.10	80.5
Nickel	"	43.3	4.0	359	77.0
Selenium	"	0.38	0.00	1.30	0.48
Silver	"	0.0	0.0	0.0	0.0
Sodium	"	1,290	486	2,460	660
Zinc	19	498.9	53.1	1,170.0	380.3
Total PCB[3], mg/kg	27	8.4	2.4	24	4.3
Total PAH[4], mg/kg	27	410	13	1,800	420

Table B2
Pre-Dredged Sediment - Summary Statistics[1] B/L Stations 775+00 to 785+00 (Mobil Oil Refinery)

Parameter	Sample Size	Mean	Minimum Value	Maximum Value	Standard Deviation
LL, %	9	41.1	32.9	44.2	3.8
PL, %	9	32.5	23.1	37.4	5.3
Total Solids, %	9	62.0	52.8	74.7	7.1
pH, mg/kg	"	7.5	7.3	7.8	0.2
TOC, mg/kg	"	24,290	17,900	32,400	4,503
Naphthalene[1]	10	0.0	0.0	0.0	0.0
Acenaphthylene	10	0.0	0.0	0.0	0.0
Acenapthene	10	0.16	0.0	0.90	0.31
Fluorene	10	0.29	0.0	1.0	0.38
Phenanthrene	10	1.2	0.0	4.0	1.4
Anthracene	10	0.59	0.0	2.2	0.84
Fluoranthene	10	0.58	0.0	2.8	0.96
Pyrene	10	0.34	0.0	2.5	0.81
Chrysene	10	0.15	0.0	0.70	0.26
B. (a) Anthracene	10	0.47	0.0	1.8	0.63
B. (b) Fluoranthene	10	0.072	0.0	0.23	0.10

(Continued)

[1] Summary statistics were calculated by assuming below detection values were zero (NYDEC 1989). All PCB Aroclors were below detection.
[2] All PAH and metals are given in mg/kg or ppm.
[3] Estimated in the field by USEPA using enzyme immunoassay techniques.
[4] Estimated in the field by USEPA using fluorometric techniques.

Table B2 (Concluded)

Parameter	Sample Size	Mean	Minimum Value	Maximum Value	Standard Deviation
B. (k) Fluoranthene	10	0.11	0.0	0.70	0.22
B. (a) Pyrene	10	0.300	0.0	0.78	0.24
Dib (a,h) Anthracene	10	0.033	0.0	0.27	0.085
B (g,h,i) Perylene	10	0.062	0.0	0.38	0.14
I. (1,2,3-cd) Pyrene	10	0.099	0.0	0.27	0.096
Arsenic[1]	10	13.6	7.4	39.9	9.9
Barium	10	107	69.5	148	21.3
Cadmium	10	0.5	0.0	1.1	0.5
Chromium	10	66.7	23.9	147	39.7
Copper	10	78.7	28.9	140	36.1
Iron	10	26,900	20,900	29,600	2,570
Lead	10	71.0	15.8	161	45.0
Manganese	10	473	359	582	75
Mercury	10	0.89	0.00	2.90	0.90
Nickel	10	25.6	17.1	31.1	4.4
Selenium	10	0.45	0.00	1.10	0.32
Silver	10	0.0	0.0	0.0	0.0
Sodium	10	941	764	1,390	207
Zinc	10	194	108	349	77
Total PCB[3], mg/kg	16	3.6	2.2	6.1	0.99
Total PAH[4], mg/kg	16	240	26	700	190

Table B3
Pre-Dredged Sediment - Summary Statistics[1] B/L Stations 560+75 to 563+00 (Dead Man's Creek)

Parameter	Sample Size	Mean	Minimum Value	Maximum Value	Standard Deviation
LL, %	4	37.0	31.7	39.6	3.6
PL, %	4	29.3	23.5	31.9	3.9
Total Solids, %	5	66.0	56.9	74.8	6.6
pH, mg/kg	5	7.5	7.4	7.7	0.1
TOC, mg/kg	5	28,660	21,500	39,600	6,835
Naphthalene[1]	5	0.0	0.0	0.0	0.0
Acenaphthylene	5	0.0	0.0	0.0	0.0
Acenapthene	5	0.10	0.0	0.38	0.16
Fluorene	5	0.26	0.0	0.72	0.34
Phenanthrene	5	8.1	0.0	38	17
Anthracene	5	0.049	0.0	0.200	0.087
Fluoranthene	5	2.9	0.0	12	5.1
Pyrene	5	3.6	0.0	18	8.1
Chrysene	5	0.45	0.0	1.1	0.55
B. (a) Anthracene	5	0.98	0.0	2.6	1.2
B. (b) Fluoranthene	5	0.11	0.0	0.28	0.15

(Continued)

1 Summary statistics were calculated by assuming below detection values were zero (NYDEC 1989). All PCB Aroclors were below detection.
2 All PAH and metals are given in mg/kg or ppm.
3 Estimated in the field by USEPA using enzyme immunoassay techniques.
4 Estimated in the field by USEPA using fluorometric techniques.

Table B3 (Concluded)

Parameter	Sample Size	Mean	Minimum Value	Maximum Value	Standard Deviation
B. (k) Fluoranthene	5	1.0	0.0	4.5	1.9
B. (a) Pyrene	5	2.0	0.0	8.0	3.4
Dib (a,h) Anthracene	5	0.05	0.0	0.2	0.11
B (g,h,i) Perylene	5	0.34	0.0	1.1	0.45
I. (1,2,3-cd) Pyrene	5	0.16	0.0	0.40	0.17
Arsenic[1]	5	18.7	7.0	47.7	17.7
Barium	5	94.4	72.6	115	16.8
Cadmium	5	2.1	0.0	4.3	1.9
Chromium	5	110	39.3	265	91.8
Copper	5	100	42.6	190	58.7
Iron	5	34,500	25,600	55,900	12,400
Lead	5	8,370	79.7	41,200	18,400
Manganese	5	458	294	913	257
Mercury	5	2.61	0.49	4.30	1.87
Nickel	5	28.8	26.0	36.2	4.3
Selenium	5	0.50	0.00	1.30	0.55
Silver	5	0.0	0.0	0.0	0.0
Sodium	5	1,170	912	1,290	158
Zinc	5	444	158	836	283
Total PCB[3], mg/kg	7	6.1	2.7	12	3.5
Total PAH[4], mg/kg	7	390	110	740	250

Appendix C
Dredging and Water Quality Monitoring Station Locations

Table C1
Opened Clamshell Bucket (w/Silt Screen) Operation, Dead Man's Creek - 28 July 1992 (Day 3)

Time	Dredge Position	Bucket Cycle Time, min	Remarks
0800	555+00	1.66	
0830	555+00	1.66	
0920	554+60	1.58	Advance dredge
0945	554+60	1.58	
1015	554+40	1.90	Advanced dredge at 1005
1050			Stopped to adjust clutch
1130	554+15		Advance dredge
1150	554+10	1.66	Resume dredging
1200			Stop dredging-lunch
1240			Resume dredging
1250	553+70	1.66	Advance dredge
1320	553+40		Advance dredge- stopped dredging to initiate slower rate
1350	553+40	4.00	Resume dredging
1440	553+40	3.83	
1500	553+40		Stopped dredging to allow WES boat to proceed for sampling
1515	553+30		Advance dredge and resume dredging
1540	553+30	3.66	
1630			Finished sampling off of crane
1635	553+10	3.75	
1645	553+10		Finished dredging for the day

Table C2
Opened Clamshell Bucket (w/Silt Screen) Operation, Dead Man's Creek - 29 July 1992 (Day 4)

Time	Dredge Position	Bucket Cycle Time, min	Remarks
0740	553+30	3.66 (Avg. of 5 cycles)	Begin dredging
0800	553+20	3.83 (")	
0840	553+00		Advance dredge
0925	553+00	3.75 (")	
1010	552+90		Advance dredge
1030	552+90	2.33 (")	Ask operator to speed up to 3 min. cycle time
1100	552+90		Advance dredge
1130	552+90	2.25	
1150	552+80		Advance dredge
1230	552+70	2.27 (Avg. of 5 cycles)	
1240	552+60		Advance dredge
1310			Stopped dredging-lunch
1345	552+60		Advance dredge and resume work
1415	552+50	1.66 (Avg. of 2 cycles)	Advance dredge
1445	552+40	2.00 (Avg. of 5 cycles)	
1545	552+20		
1630	552+00		Finished dredging for the day

Table C3
Opened Clamshell Bucket Operation, Mobil Oil - 30 July 1992 (Day 5)

Time	Dredge Position	Bucket Cycle Time, min	Remarks
1020	775+00		Begin dredging
1045	775+40	2.33 (Avg. of 2 cycles)	
1135	775+40	3.00 "	
1235	775+50	2.58 (Avg. of 3 cycles)	
1255			Stopped dredging-lunch
1330	775+30		Advance dredge, resume work
1425	775+60	2.50	
1550	775+75		Operate at "normal" speed
1715	775+75		Finished dredging for the day

Table C4
Opened Clamshell Bucket Operation, Mobil Oil - 31 July 1992 (Day 6)

Time	Dredge Position	Bucket Cycle Time, min	Remarks
0730			Begin dredging
1000	775+90	2.00	
1030	775+70 (off side of crane barge)		Advance dredge
1100	775+70 "	1.75	Still moving-Scow broke loose
1200			Stopped dredging-lunch, "Mr. Dave" sampling
1235			Advance dredge
1240			Begin switch to closed bucket

Table C5
Closed Clamshell Bucket Operation, Mobil Oil - 31 July 1992 (Day 7)

Time	Dredge Position	Bucket Cycle Time, min	Remarks
1400	776+00 "	3.00 (one cycle)	Closed bucket hooked up
1630	776+20 "	3.00 "	
1700			Finished dredging for the day

Table C6
Closed Clamshell Bucket Operation, Mobil Oil - 1 August 1992 (Day 8)

Time	Dredge Position	Bucket Cycle Time, min	Remarks
0800	776+00	3.00 (Avg. of 5 cycles)	Begin dredging
0915	776+20	3.33 "	
1020	776+10	3.00 "	
1120	776+30	3.33 "	
1205	776+20		Advance dredge
1230	776+30	3.66	
1330			Dredge down-repairing compressor
1430	776+50		Advance dredge
1530	776+60	2.83 (Avg. of 3 cycles)	Advance dredge
1630	776+50	3.00 (Avg. of 5 cycles)	
1645	776+80		Moved after TSS samples and stopped for the day

Table C7
Closed Clamshell Bucket Operation, Mobil Oil - 3 August 1992 (Day 9)

Time	Dredge Position	Bucket Cycle Time, min	Remarks
0740	776+80	1.33 (Avg. of 5 cycles)	Start dredging at "normal" speed
0800	777+00		
0810			Dredge down
0840	777+00	1.50 "	Resume dredging
0900	777+00		Advance dredge
0945	777+20	1.33 "	
1000	777+40		Advance dredge
1045	777+50		Advance dredge
1115	777+60	1.25 "	
1200			Shut dredge down to sample point 00, and do downstream transects
1245	777+50		Transects complete, resume dredging
1300		1.50 "	
1335	777+80		Advance dredge
1415	778+10	1.75 "	Advance dredge
1500	778+25		Stop dredging, full scow

Table C8
Closed Clamshell Bucket Operation, Mobil Oil - 4 August 1992 (Day 10)

Time	Dredge Position	Bucket Cycle Time, min	Remarks
0740	778+30		Begin dredging
0800	778+30	2.00 (Avg. of 3 cycles)	
0810	778+40		Advance dredge
0900			Ready to move but D.S. sampling is ongoing so we do not fire up tug
0945	778+10 (work corner of barge)		Advance dredge and resume
1000	778+10	2.00 (Avg. of 5 cycles)	
1045	778+60	1.92	Advance dredge
1200	779+20		Advance dredge
1300		1.83 (Avg. of 5 cycles)	
1315	779+00 "		Advance dredge
1415	779+25 "	2.00 (Avg. of 2 cycles)	Advance dredge
1430	779+40	1.92 (Avg. of 5 cycles)	
1515	779+50		Stop dredge to allow sample
1545	779+60		Sampling done-advance dredge
1630	779+50	2.00 (Avg. of 5 cycles)	
1700	779+60		Finished dredging for the day

Table C9
Submersible Pump Operation, Mobil Oil - 6 August 1992 (Day 12)

Time	Dredge Position	Remarks
0740	779+60	Start dredge
0800	780+00	
0830	779+90	
0830		Move dredge, tug Mackie stirs up large mounts of sediment all around sampling array
0845	780+00	
1000	780+00	Stop dredging, hoses from sampling array clog pump and are chewed up by pump
1115		Resume dredging
1200	780+40	Move dredge
1330	780+40	Stop dredging to change scow
1430	780+50	Resume dredging after changing scow and welding output hose to scow
1700	780+50	Stop dredging and wait for Buffalo State to finish down stream sampling
1730		Move forward- stop for the day

Table C10
Submersible Pump Operation, Mobil Oil - 7 August 1992 (Day 13)

Time	Dredge Position	Remarks
0820	780+70	Start dredging with pump
0930	780+60	Dredging side slope area
0940		Great Lakes ready to move, tell him to wait until downstream sampling is done
0950		Move dredge
1005	780+70	Resume dredging
1100	780+80	
1133	780+80	Stop dredging to see if pump is clogged
1142		Resume dredging
1148		Got sampling pumps working
1200		Move dredge
1212	781+20	Resume dredging
1340	781+20	Stop dredging
1500	781+20	Move dredge
1615	781+30	Working 10-35 ft from shore, navigation channel closer to shore here
1700	781+40	Stop dredging, still filling scow #59

Table C11
Submersible Pump Operation, Dead Man's Creek - 8 August 1992 (Day 14)

Time	Dredge Position	Remarks
0700		Start up, raise boom, tape sample lines, etc.
0845	562+80	Start dredging, approximately 15-35 feet off the bank
1030	562+50	Move dredge
1045	562+50	Resume dredging
1200	562+10	
1210		Move dredge and repair sampling array
1330		
1330	562+10	Resume dredging
1400	561+80	
1415		Move dredge
1425	561+60	Resume dredging
1515	561+60	
1520		Move dredge
1525	561+30	Resume dredging
1605	561+30	Stop dredging to check clogged pump
1615	561+30	Resume dredging
1630	561+30	Stop dredging- demonstration completed

Table C12
Dead Man's Creek (Downstream) Water Quality Monitoring Station Locations - Opened Clamshell Bucket w/Sediment Dispersion Barrier

Sample Period	Dredge Position (B/L Station)[1]	Water Quality Sample Station Position (B/L Station)/Up or Downstream Distance from Dredge, ft[2]								
		13-15	7-9	3[3]	2 & 4	0[4]	1	5 & 6	10-12	16-18
27 July 1992 - Day 2										
1(AM)	555+00	586+00/ 3,100	558+00/ 300	554+15/ 90	554+00/ 100	555+00/ 0	NR	552+00/ 300	548+57/ 640	532+00/ 2,300
2 (1445- 1553)	"	"	"	"	"	"	"	"	"	"
3 (1638-1738)	"	"	"	"	"	"	"	"	"	"
28 July 1992 - Day 3										
1 (0721-1020)	555+00 to 554+40	586+00/ 3,130	558+00/ 330	555+55/ 9	554+00/ 7	554+70/ 0	553+00/ 170	552+00/ 27	548+57/ 610	532+00/ 2,270
2 (1136-1310)	554+15 to 553+70	586+00/ 3,210	558+00/ 410	553+93/ 9	554+00/ 1	553+92/ 0	553+00/ 90	552+00/ 19	548+57/ 540	532+00/ 2,190
3 (1500-1739)	553+40 to 553+10	586+00/ 3,280	558+00/ 480	554+10/ 90	554+00/ 80	553+25/ 0	553+00/ 30	552+00/ 130	548+57/ 470	532+00/ 2,130
29 July 1992 - Day 4										
1 (0716-0949)	553+30 to 553+00	586+00/ 3,290	558+00/ 490	554+00/ 90	552+00/ 120	553+15/ 0	552+00/ 120	550+00/ 320	548+57/ 460	532+00/ 2,120
2 (1100-1203)	552+90 to 552+80	586+00/ 3,320	558+00/ 520	553+70/ 90	552+00/ 90	552+85/ 0	552+00/ 90	550+00/ 290	548+57/ 430	532+00/ 2,090
3 (1300-1525)	552+60 to 552+40	586+00/ 3,350	558+00/ 550	553+55/ 90	552+00/ 50	552+50/ 0	552+00/ 50	550+00/ 250	548+57/ 390	532+00/ 2,050

Note: NR = not recorded.
[1] Position of dredge barge bow.
[2] Sample station positions were visually located and distributed across width of channel. Baseline is not always parallel with river centerline. Distance from dredge rounded to nearest 10 ft. Station location accuracy +/- ??? ft.
[3] Taken off dredge barge; 85 ft from bow.
[4] Taken off dredge barge, approx. 5 ft from bow, for buckets and with sampling array, mounted on pump, for the submersible pump.

Table C13
Mobil Oil Refinery Water Quality Monitoring Station Locations - Opened Clamshell Bucket

Sample Period	Dredge Position (B/L Station)[1]	Water Quality Sample Station Position (B/L Station)/Up or Downstream Distance from Dredge, ft[2]								
		13-15	7-9	0[4]	4	3[3]	1 & 2	5 & 6	10-12	16-18
30 July 1992 - Day 5										
1 (0803-0906)	775+00 to 775+50	792+00/ 1,680	777+00/ 180	775+25/ 0	775+25/ 0	774+40/ 90	774+00/ 130???	???	770+20/ 510	766+00/ 930
2 (1237-1320)	775+50	792+00/ 1,650	777+00/ 150	775+50/ 0	775+50/ 0	774+65/ 90	774+00/ 150???	???	770+20/ 530	766+00/ 950
3 (1445-1518)	775+60	792+00/ 1,640	777+00/ 140	775+60/ 0	775+60/ 0	774+75/ 90	774+00/ 160???	???	770+20/ 540	766+00/ 960
4 (1600-1747)	775+75	792+00/ 1,630	777+00/ 130	775+75/ 0	775+75/ 0	774+90/ 90	774+00/ 180???	???	770+20/ 560	766+00/ 980
31 July 1992 - Day 6										
1 (0732-1045)	775+75 to 775+90??	792+00/ 1,620	777+00/ 120???	775+83/ 0	775+83/ 0	774+98/ 90	774+00/ 180???	???	770+20/ 560???	766+00/ 980
2 (1200-1250)	775+90	792+00/ 1,610	777+00/ 110???	775+90/ 0	775+90/ 0	775+05/ 90	774+00/ 190???	???	770+20/ 570???	766+00/ 990

Note: NR = not recorded.
[1] Position of dredge barge bow.
[2] Sample station positions were visually located and distributed across width of channel. Baseline is not always parallel with river centerline. Distance from dredge rounded to nearest 10 ft. Station location accuracy +/- ??? ft.
[3] Taken off dredge barge; 85 ft from bow.
[4] Taken off dredge barge, approx. 5 ft from bow, for buckets and with sampling array, mounted on pump, for the submersible pump.

Table C14
Mobil Oil Refinery Water Quality Monitoring Station Locations - Closed Clamshell Bucket

Sample Period	Dredge Position (B/L Station)[1]	Water Quality Sample Station Position (B/L Station)/Up or Downstream Distance from Dredge, ft[2]								
		13-15	7-9	0[4]	4	3[3]	1 & 2	5 & 6	10-12	16-18
31 July 1992 - Day 7										
1 (1500-1720)	776+00 to 776+20	792+00/ 1590	777+00/ 90???	776+10/ 0	776+10/ 0	775+25/ 90	774+00/ 210???	???	770+20/ 590???	766+00/ 1,010
1 August 1992 - Day 8										
1 (0747-1000)	776+20	792+00/ 1,580	778+00/ 180	776+20/ 0	776+20/ 0	775+35/ 90	774+30/ 190	774+00/ 220	772+00/ 420	766+00/ 1,020
2 (1200-1245)	776+30	792+00/ 1,570	778+00/ 170	776+30/ 0	776+30/ 0	775+45/ 90	774+80/ 150	774+00/ 230	772+00/ 430	766+00/ 1,030
3 (1530-1712)	776+60 to 776+80	792+00/ 1,530	778+00/ 130	776+70/ 0	776+70/ 0	775+85/ 90	775+10/ 160	774+00/ 270	772+00/ 470	766+00/ 1,070
3 August 1992 - Day 9										
1 (0803-1022)	777+00 to 777+40	792+00/ 1,480	779+00/ 180	777+20/ 0	777+20/ 0	776+35/ 90	775+70/ 150	775+00/ 220	772+00/ 520	766+00/ 1,120
2 (1200-1243)	777+50 to 777+60	792+00/ 1,450	779+00/ 150	777+55/ 0	777+55/ 0	776+70/ 90	775+70/ 190	775+00/ 260	772+00/ 560	766+00/ 1,160
3 (1500-1708)	778+25	792+00/ 1,380	779+00/ 80	778+25/ 0	778+25/ 0	777+40/ 90	776+80/ 150	775+00/ 330	772+00/ 630	766+00/ 1,230
4 August 1992 - Day 10										
1 (0849-1036)	778+40 to 778+60	792+00/ 1,350	779+00/ 50	778+50/ 0	778+50/ 0	777+65/ 90	776+30/ 220	775+00/ 350	772+00/ 650	766+00/ 1,250
2 (1200-1259)	779+20	792+00/ 1,280	779+00/ -20???	779+20/ 0	779+20/ 0	778+35/ 90	777+00/ 220	775+00/ 420	772+00/ 720	766+00/ 1,320
3 (1500-1705)	779+40 to 779+60	792+00/ 1,250	779+00/ -50???	779+50/ 0	779+50/ 0	778+65/ 90	778+00/ 150	775+00/ 450	772+00/ 750	766+00/ 1,350

Note: NR = not recorded.
[1] Position of dredge barge bow.
[2] Sample station positions were visually located and distributed across width of channel. Baseline is not always parallel with river centerline. Distance from dredge rounded to nearest 10 ft. Station location accuracy +/- ??? ft.
[3] Taken off dredge barge; 85 ft from bow.
[4] Taken off dredge barge, approx. 5 ft from bow, for buckets and with sampling array, mounted on pump, for the submersible pump.

Table C15
Mobil Oil Refinery Water Quality Monitoring Station Locations - Submersible Pump

Sample Period	Dredge Position (B/L Station)[1]	Water Quality Sample Station Position (B/L Station)/Up or Downstream Distance from Dredge, ft[2]								
		13-15	7-9	0[4]	4	3[3]	1 & 2	5 & 6	10-12	16-18
6 August 1992 - Day 12										
1 (0730-1003)	779+60 to 780+00	792+00/ 1,220	782+00/ 220	779+80/ 0	779+80/ 0	778+95/ 90	778+00/ 180	777+00/ 280	774+00/ 580	766+00/ 1,380
2 (1230-1308)	780+40	792+00/ 1,160	782+00/ 160	780+40/ 0	780+40/0	779+55/ 90	778+75/ 170	777+00/ 340	774+00/ 640	766+00/ 1,440
3 (1530-1718)	780+50	792+00/ 1,150	782+00/ 150	780+50/ 0	780+50/ 0	779+65/ 90	779+50/ 100	777+00/ 350	774+00/ 650	766+00/ 1,450
7 August 1992 - Day 13										
1 (0740-0941)	780+60 to 780+70	792+00/ 1,140	782+00/ 140	780+65/ 0	780+65/ 0	779+80/ 9	780+00/ 70	777+00/ 37	774+00/ 670	766+00/ 1,470
2 (1015-1110)	780+70 to 780+80	792+00/ 1,130	782+00/ 130	780+75/ 0	780+75/ 0	779+90/ 9	780+00/ 80	777+00/ 38	774+00/ 680	766+00/ 1,480
3 (1130-1204)	780+80	792+00/ 1,120	782+00/ 120	780+80/ 0	780+80/ 0	779+95/ 9	780+00/ 80	777+00/ 38	774+00/ 680	766+00/ 1,480
4 (1343-1413)	781+20	792+00/ 1,080	782+00/ 8	781+20/ 0	781+20/ 0	780+35/ 9	780+00/ 120	777+00/ 42	774+00/ 720	766+00/ 1,520
5 (1530-1732)	781+20 to 781+40	792+00/ 1,070	782+00/ 7	781+30/ 0	781+30/ 0	780+45/ 9	780+00/ 130	777+00/ 43	774+00/ 730	766+00/ 1,530

Note: NR = not recorded.
[1] Position of dredge barge bow.
[2] Sample station positions were visually located and distributed across width of channel. Baseline is not always parallel with river centerline. Distance from dredge rounded to nearest 10 ft. Station location accuracy +/- ??? ft.
[3] Taken off dredge barge; 85 ft from bow.
[4] Taken off dredge barge, approx. 5 ft from bow, for buckets and with sampling array, mounted on pump, for the submersible pump.

Table C16
Dead Man's Creek (Upstream) Water Quality Monitoring Station Locations - Submersible Pump

Sample Period	Dredge Position (B/L Station)[1]	Water Quality Sample Station Position (B/L Station)/Up or Downstream Distance from Dredge, ft[2]								
		13-15	7-9	3[3]	2 & 4	0[4]	1	5 & 6	10-12	16-18
8 August 1992 - Day 14										
1 (0742-1030)	562+80 to 562+50	586+00/ 2,340	569+00/ 640	563+50/ 90	562+65/ 0	562+65/ 0	???	560+00/ 270	554+00/ 870	532+00/ 3,070
2 (1253-1420)	562+10 to 561+80	586+00/ 2,410	569+00/ 710	562+80/ 90	561+95/ 0	561+95/ 0	???	560+00/ 200	554+00/ 800	532+00/ 3,000
3 (1530-1727)	561+30	586+00/ 2,470	569+00/ 770	562+15/ 90	561+30/ 0	561+30/ 0	???	560+00/ 130	554+00/ 730	532+00/ 2,930

Note: NR = not recorded.
[1] Position of dredge barge bow.
[2] Sample station positions were visually located and distributed across width of channel. Baseline is not always parallel with river centerline. Distance from dredge rounded to nearest 10 ft. Station location accuracy +/- ??? ft.
[3] Taken off dredge barge; 85 ft from bow.
[4] Taken off dredge barge, approx. 5 ft from bow, for buckets and with sampling array, mounted on pump, for the submersible pump.

Appendix D
Background TSS Summary Statistics, Stations 13-15

Table D1
Dead Man's Creek (Downstream) Background TSS Summary Statistics and Estimates - Opened Clamshell Bucket with Sediment Dispersion Barrier

Day	Sample Station	Sample Period	Sample Depth	Sample Size	Mean[1]	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
2-min Bucket Cycle Time										
3	13-15	1	1-3	9	83.6	73.4	90.5	4.8	23.2	1.6
3	13-15	2			70					
4	13-15	2			35					
4	13-15	3	1-3	9	24.6	20.9	31.0	3.5	12.4	1.2
4-min Bucket Cycle Time										
3	13-15	3	1-3	9	55.4	51.2	60.8	3.7	13.4	1.2
4	13-15	1	1-3	9	45.7	24.0	89.0	19.0	359.4	6.3
Bucket Cycle Time N/A										
2	13-15	1	1-3	9	186.1	111.0	232.0	41.5	1,725.6	13.8
2	13-15	2	1-3		175					
2	13-15	3	1-3		175					

[1] Whole numbers are estimates.

Table D2
Mobil Oil Refinery Background TSS Summary Statistics and Estimates - Opened Clamshell Bucket

Day	Sample Station	Sample Period	Sample Depth	Sample Size	Mean[1]	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
2-min Bucket Cycle Time										
6	13-15	1	1-3	9	132.5	94.5	171.0	32.0	1,023.4	10.7
6	13-15	2			155					
3-min Cycle Time										
5	13-15	1	1-3	10	97.7	85.7	114.0	7.8	60.4	2.5
5	13-15	2			70					
5	13-15	3			60					
5	13-15	4	1-3	9	43.7	32.4	57.7	7.1	50.2	2.4

[1] Whole numbers are estimates.

Table D3
Mobil Oil Refinery Background TSS Summary Statistics and Estimates - Closed Clamshell Bucket

Day	Sample Station	Sample Period	Sample Depth	Sample Size	Mean[1]	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
1-min Bucket Cycle Time										
9	13-15	1	1-3	9	28.4	9.6	51.8	14.0	196.2	4.7
9	13-15	2			20					
2-min Bucket Cycle Time										
9	13-15	3	1-3	9	15.8	10.3	22.1	4.7	21.7	1.6
10	13-15	1	1-3	10	34.0	20.5	48.0	8.2	67.0	2.6
10	13-15	2			100					
10	13-15	3	1-3	9	409.4	182.0	688.0	134.9	18,205.8	45.0
3-min Bucket Cycle Time										
7	13-15	1	1-3	10	194.5	152.0	244.0	37.3	1,390.2	11.8
8	13-15	1	1-3	9	151.8	122.0	164.0	13.4	180.1	4.5
8	13-15	2			90					
8	13-15	3	1-3	9	33.9	17.4	50.8	10.4	107.7	3.5

[1] Whole numbers are estimates.

Table D4
Mobil Oil Refinery and Dead Man's Creek (Upstream) Background TSS Summary Statistics and Estimates - Submersible Pump

Day	Sample Station	Sample Period	Sample Depth	Sample Size	Mean[1]	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
12	13-15	1	1-3	10	32.1	22.1	51.0	8.1	65.7	2.6
12	13-15	2			25					
12	13-15	3	1-3	10	18.7	12.9	22.7	3.1	9.6	1.0
13	13-15	1	1-3	9	37.5	17.0	71.4	20.4	415.2	6.8
13	13-15	2			30					
13	13-15	3			25					
13	13-15	4			20					
13	13-15	5	1-3	9	14.0	8.0	16.2	2.4	5.8	0.8
14	13-15	1	1-3	9	18.2	11.4	27.5	5.3	28.1	1.8
14	13-15	2			15					
14	13-15	3	1-3	8	14.7	10.5	18.0	2.6	7.0	0.9

[1] Whole numbers are estimates.

Appendix E
Total Suspended Solids Data

Table E1
Date: 24 July 92 - Dead Man's Creek

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6035-20	13	1310	3	19	59.1		
6035-19	13	1310	9	19	60.0		
6035-22	13	1310	14	19	61.2		
6035-21	14	1310	3		74.7		
6035-16	14	1310	9		70.9		
6035-15	14	1310	14		73.9		
6035-14	15	1310	3	11	81.6		
6035-17	15	1310	5	11	83.8		
6035-13	15	1310	8	11	91.2		
6035-11	16	1600	3		314.0		
6035-8	16	1600	12		317.0		
6035-10	16	1600	18		360.0		
6035-9	17	1600	3		309.0		
6035-5	17	1600	14		377.0		
6035-23	17	1600	14		330.0		
6035-24	17	1600	21		320.0		
6035-6	18	1600	3		304.0		
6035-29	18	1600	13		343.0		
6035-7	18	1600	20		303.0		

Table E2
Date: 27 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/ Silt Screen)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6068-16	13	AM	3	25	111.0		0.20
6068-17	13	AM	12	25	218.0		0.25
6068-18	13	AM	19	25	232.0		0.28
6068-19	14	AM	3	29	161.0		0.20
6069-1	14	AM	14	29	147.0		0.25
6069-2	14	AM	22	29	172.0		0.25
6069-3	15	AM	3	26	189.0		0.10
6069-4	15	AM	13	26	226.0		0.10
6069-5	15	AM	20	26	219.0		0.12
6069-6	16	AM	3	25	95.9	-90.2	0.20
6069-7	16	AM	12	25	59.1	-127.0	0.35
6069-8	16	AM	19	25	58.4	-127.7	0.30
6069-9	17	AM	3	29	57.6	-128.5	0.35
6069-10	17	AM	14	29	66.8	-119.3	0.36
6069-11	17	AM	22	29	71.1	-115.0	0.40
6069-12	18	AM	3	22	53.4	-132.7	0.20
6069-13	18	AM	11	22	74.3	-111.8	0.21
Sample Period 2							
6066-13	07	1533	2	24	146.0	-29	
6066-14	07	1534	12	24	167.0	-8	
6066-15	07	1534	18	24	188.0	13	
6066-16	07	1535	22	24	195.0	20	
6066-17	08	1541	3	28	152.0	-23	
6067-6	08	1534	13	28	183.0	8	
6066-18	08	1542	14	28	176.0	1	
6066-19	08	1543	21	28	188.0	13	
6067-1	08	1534	25	28	187.0	12	
6067-2	09	1551	2		168.0	-7	

(Sheet 1 of 4)

Table E2 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6067-3	09	1552	13		173.0	-2	
6067-4	09	1553	18		140.0	-35	
6067-5	09	1553	24		162.0	-13	
6038-11	00	1445	2	19	162.0	-13	
6038-10	00	1445	9	19	175.0	0	
6038-7	00	1445	14	19	212.0	37	
6038-6	00	1445	17	19	197.0	22	
6038-12	03	1445	9	19	217.0	42	
6038-9	03	1445	9	19	215.0	40	
6038-8	03	1445	14	19	202.0	27	
6038-5	03	1445	17	19	148.0	-27	
6067-7	01	1445	3	27	141.0	-34	
6067-8	01	1445	12	27	152.0	-23	
6067-9	01	1445	20	27	218.0	43	
6067-10	01	1445	27	27	214.0	39	
6067-11	02	1510	3	30	165.0	-10	
6067-12	02	1510	13	30	184.0	9	
6067-13	02	1510	22	30	203.0	28	
6067-14	02	1510	27	30	278.0	103	
6066-1	04	1454	3		145.0	-30	
6066-2	04	1455	13		200.0	25	
6066-3	04	1456	20		185.0	10	
6066-4	04	1457	28		192.0	17	
6066-5	05	1505	1		155.0	-20	
6066-6	05	1506	7		193.0	18	
6066-7	05	1508	10		196.0	21	
6066-8	05	1509	14		202.0	27	
6066-9	06	1516	2		152.0	-23	
6066-10	06	1517	12		199.0	24	
6066-11	06	1517	18		197.0	22	

(Sheet 2 of 4)

Table E2 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6066-12	06	1518	24		196.0	21	
6039-4	10	1520	3	25	108.0	-67	
6038-15	10	1522	11	25	111.0	-64	
6039-1	10	1525	19	25	157.0	-18	
6038-20	10	1527	22	25	171.0	-4	
6038-19	11	1455	3	28	110.0	-65	0.40
6039-2	11	1455	13	28	151.0	-24	0.30
6039-5	11	1457	21	28	171.0	-4	0.42
6038-4	11	1500	25	28	124.0	-51	0.40
6038-18	12	1541	3	28	107.0	-68	
6038-16	12	1541	13	28	146.0	-29	
6039-3	12	1544	21	28	135.0	-40	
6038-17	12	1546	25	28	128.0	-47	
Sample Period 3							
6037-6	07	1720	1		158.0	-17	
6037-9	07	1722	12		191.0	16	
6037-12	07	1724	18		144.0	-31	
6037-16	07	1726	24		196.0	21	
6037-19	08	1730	3		148.0	-27	
6038-3	08	1732	15		195.0	20	
6037-7	08	1724	21		150.0	-25	
6037-8	08	1726	28		182.0	7	
6037-13	09	1732	1	14	164.0	-11	
6037-17	09	1734	6	14	190.0	15	
6037-18	09	1736	10	14	169.0	-6	
6038-2	09	1738	13	14	172.0	-3	
6036-20	01	1700	3	25	178.0	3	
6036-16	01	1700	12	25	178.0	3	
6036-19	01	1700	19	25	199.0	24	
6036-17	01	1700	22	25	173.0	-2	

(Sheet 3 of 4)

Table E2 (Concluded)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6036-13	02	1710	3	27	155.0	-20	
6036-15	02	1710	12	27	195.0	20	
6036-14	02	1710	20	27	204.0	29	
6036-18	02	1710	24	27	204.0	29	
6037-2	04	1650	3	30	149.0	-26	
6037-3	04	1652	14	30	176.0	1	
6037-4	04	1654	21	30	189.0	14	
6037-14	04	1654	27	30	199.0	24	
6037-5	05	1700	2		160.0	-15	
6037-10	05	1702	10		188.0	13	
6036-12	05	1706	10		188.0	13	
6037-15	06	1712	13		174.0	-1	
6037-20	06	1714	20		194.0	19	
6037-11	06	1710	25		151.0	-24	
6036-11	06	1716	26		132.0	-43	
6036-5	10	1638	3	29	146.0	-29	
6036-4	10	1639	13	29	153.0	-22	
6036-8	10	1641	22	29	133.0	-42	
6036-9	10	1643	26	29	164.0	-11	
6036-10	11	1644	3	29	133.0	-42	0.60
6038-14	11	1650	13	29	145.0	-30	0.575
6036-2	11	1652	22	29	109.0	-66	0.49
6036-7	11	1653	26	29	173.0	-2	0.45
6036-6	11	1653	26	29	183.0	8	0.45
6036-3	12	1712	3	29	137.0	-38	
6036-1	12	1713	13	29	163.0	-12	
6038-13	12	1716	22	29	166.0	-9	
6037-1	12	1715	26	29	172.0	-3	

(Sheet 4 of 4)

Table E3
Date: 28 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/ Silt Screen)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6048-19	13	0820	3		82.7		0.02
6049-4	13	0822	12		87.0		0.00
6049-7	13	0825	19		86.2		0.00
6049-3	14	0830	3		84.6		0.08
6049-5	14	0832	14		83.3		0.10
6049-6	14	0835	21		90.5		0.10
6049-1	15	0840	3		73.1		0.02
6048-18	15	0844	14		84.0		0.05
6049-2	15	0848	21		80.9		0.10
6039-9	07	0954	2		57.4	-26.2	
6039-8	07	0954	13		58.9	-24.7	
6039-7	07	0955	19		82.6	-1	
6039-6	07	0955	23		80.1	-3.5	
6039-13	08	0959	3		78.6	-5	
6039-12	08	1000	14		81.3	-2.3	
6039-11	08	1001	20		82.1	-1.5	
6039-10	08	1003	26		82.1	-1.5	
6050-18	09	1010	2		80.0	-3.6	
6039-16	09	1012	13		89.4	5.8	
6039-15	09	1015	19		85.8	2.2	
6039-14	09	1020	23		92.6	9	
6053-11	00	0900	2	19	90.9	7.3	
6055-6	00	0900	9	19	80.0	-3.6	
6053-7	00	0900	14	19	91.6	8	
6053-8	00	0900	17	19	93.0	9.4	
6053-6	03	0900	2	19	87.6	4	
6055-11	03	0900	2	19	77.9	-5.7	
6053-18	03	0900	9	19	90.9	7.3	

(Sheet 1 of 7)

Table E3 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6055-9	03	0900	14	19	88.0	4.4	
6055-7	03	0900	17	19	91.5	7.9	
6040-11	01	0900	3	26	90.1	6.5	
6040-9	01	0900	11	26	91.2	7.6	
6040-10	01	0900	19	26	144.0	60.4	
6040-12	01	0900	23	26	143.0	59.4	
6040-8	02	0920	3	26	82.3	-1.3	
6040-5	02	0920	11	26	86.7	3.1	
6040-7	02	0920	19	26	124.0	40.4	
6040-6	02	0920	19	26	110.0	26.4	
6040-13	02	0920	23	26	164.0	80.4	
6050-12	04	0910	3	30	88.2	4.6	
6039-17	04	0912	14	30	95.5	11.9	
6050-19	04	0910	21	30	96.6	13	
6050-17	04	0914	27	30	108.0	24.4	
6050-8	05	0924	1	12	80.4	-3.2	
6050-15	05	0925	6	12	86.9	3.3	
6050-14	05	0926	9	12	95.6	12	
6050-13	05	0927	11	12	95.0	11.4	
6050-9	06	0944	3		72.4	-11.2	
6050-10	06	0946	14		88.3	4.7	
6050-16	06	0946	14		94.9	11.3	
6050-11	06	0946	20		64.7	-18.9	
6050-7	06	0945	26		96.0	12.4	
6050-3	10	0909	3	26	88.1	4.5	
6050-4	10	0910	12	26	88.6	5	
6050-5	10	0911	20	26	106.0	22.4	
6050-6	10	0912	23	26	92.5	8.9	
6050-2	11	0928	3	29	90.1	6.5	0.08
6050-1	11	0929	13	29	92.7	9.1	0.10

(Sheet 2 of 7)

Table E3 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6049-19	11	0929	22	29	103.0	19.4	0.11
6049-18	11	0930	26	29	130.0	46.4	0.10
6049-17	12	0937	3	26	92.5	8.9	
6049-16	12	0938	12	26	106.0	22.4	
6049-15	12	0938	20	26	107.0	23.4	
6049-14	12	0938	23	26	114.0	30.4	
6048-6	16	0721	3	25	94.2	10.6	
6048-3	16	0723	12	25	114.0	30.4	
6048-2	16	0725	19	25	126.0	42.4	
6048-7	16	0727	19	25	114.0	30.4	
6048-8	17	0739	3	28	94.5	10.9	
6048-10	17	0739	3	28	102.0	18.4	
6048-11	17	0740	21	28	96.7	13.1	
6048-5	18	0750	3	25	91.3	7.7	
6048-9	18	0754	12	25	106.0	22.4	
6048-4	18	0800	19	25	105.0	21.4	
Sample Period 2							
6043-11	07	1214	2		56.4	-14	
6043-12	07	1215	13		81.9	12	
6043-13	07	1216	19		59.9	-10	
6043-14	07	1217	23		83.0	13	
6043-18	08	1220	3		71.9	2	
6043-16	08	1222	14		82.1	12	
6043-15	08	1223	20		73.9	4	
6043-17	08	1225	26		70.1	0	
6043-19	09	1227	1	16	59.7	-10	
6043-20	09	1229	8	16	57.8	-12	
6044-2	09	1230	12	16	75.8	6	
6044-1	09	1232	14	16	51.8	-18	
6055-3	00	1310	4	21	67.0	-3	

(Sheet 3 of 7)

Table E3 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6053-17	00	1310	11	21	86.7	17	
6041-20	10	1138	25	28	148.0	78	
6041-13	11	1145	3	29	75.5	6	0.15
6041-12	11	1148	13	29	87.2	17	0.15
6041-15	11	1151	22	29	104.0	34	0.09
6041-14	11	1154	26	29	124.0	54	0.08
6041-19	12	1209	3	27	68.2	-2	
6041-16	12	1210	12	27	68.2	-2	
6041-18	12	1210	20	27	102.0	32	
6041-17	12	1211	24	27	112.0	42	
Sample Period 3							
6057-6	13	1627	3	26	51.2		0.10
6057-12	13	1629	13	26	52.8		0.165
6057-18	13	1630	20	26	57.7		0.15
6057-4	14	1637	3	28	51.5		0.15
6057-16	14	1639	14	28	60.8		0.10
6057-5	14	1638	20	28	58.2		0.15
6057-17	15	1646	3	21	54.6		0.10
6057-9	15	1648	13	21	52.3		0.165
6057-10	15	1650	20	21	59.3		0.10
6052-3	07	1545	2		69.3	13.9	
6052-4	07	1545	13		69.8	14.4	
6052-5	07	1545	17		72.0	16.6	
6052-6	07	1547	23		80.0	24.6	
6051-18	08	1551	4		58.9	3.5	
6052-2	08	1551	15		67.1	11.7	
6052-1	08	1552	20		68.1	12.7	
6051-19	08	1553	27		95.2	39.8	
6051-14	09	1555	2	24	63.9	8.5	
6051-15	09	1557	13	24	64.4	9	

(Sheet 4 of 7)

Table E3 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6051-16	09	1558	18	24	72.2	16.8	
6051-17	09	1558	22	24	75.1	19.7	
6054-15	00	1525	4	21	63.3	7.9	
6054-2	00	1525	11	21	78.7	23.3	
6054-9	00	1525	11	21	74.6	19.2	
6054-17	00	1525	16	21	80.9	25.5	
6054-14	00	1525	19	21	90.8	35.4	
6054-1	03	1525	4	21	58.3	2.9	
6054-11	03	1525	11	21	63.8	8.4	
6053-19	03	1525	16	21	70.2	14.8	
6054-18	03	1525	19	21	99.4	44	
6046-4	01	1500	3	25	72.8	17.4	
6046-6	01	1500	11	25	80.6	25.2	
6046-7	01	1500	19	25	81.3	25.9	
6046-8	01	1500	23	25	92.4	37	
6046-1	02	1520	3	26	60.6	5.2	
6046-3	02	1520	12	26	87.1	31.7	
6046-5	02	1520	20	26	107.0	51.6	
6046-2	02	1520	23	26	104.0	48.6	
6052-15	04	1503	4		62.8	7.4	
6052-16	04	1504	15		74.0	18.6	
6052-18	04	1507	27		67.4	12	
6052-11	05	1515	3		58.8	3.4	
6052-12	05	1516	11		78.8	23.4	
6052-13	05	1516	16		83.1	27.7	
6052-14	05	1517	20		83.8	28.4	
6052-7	06	1523	4		68.1	12.7	
6052-8	06	1524	15		114.0	58.6	
6052-10	06	1525	20		73.1	17.7	
6052-9	06	1524	27		112.0	56.6	

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Table E3 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6051-3	10	1503	3	27	71.9	16.5	
6051-4	10	1504	12	27	84.7	29.3	
6051-5	10	1504	20	27	75.6	20.2	
6051-1	10	1505	24	27	81.8	26.4	
6051-9	11	1512	3	29	81.0	25.6	0.20
6051-2	11	1512	3	29	76.8	21.4	0.20
6051-8	11	1513	13	29	92.5	37.1	0.19
6051-7	11	1514	22	29	90.3	34.9	0.165
6051-13	11	1515	26	29	104.0	48.6	0.19
6051-10	12	1531	3	27	78.5	23.1	
6051-11	12	1532	12	27	82.4	27	
6051-6	12	1532	20	27	79.2	23.8	
6051-12	12	1533	24	27	77.2	21.8	
6057-15	16	1712	3	25	13.4	-42	
6057-13	16	1713	12	25	46.8	-8.6	
6057-14	16	1714	19	25	75.5	20.1	
6056-1	17	1722	3	28	12.2	-43.2	
6055-18	17	1723	14	28	69.2	13.8	
6057-11	17	1724	21	28	75.6	20.2	
6055-17	18	1734	3	24	10.9	-44.5	
6057-7	18	1736	12	24	61.2	5.8	
6055-19	18	1736	12	24	61.9	6.5	
6057-8	18	1739	18	24	72.2	16.8	
6055-16	00	1030	2	19	84.9		
6053-4	00	1030	9	19	87.8		
6053-10	00	1030	14	19	85.4		
6053-12	00	1030	17	19	85.0		
6055-13	00	1420	4	21	68.5		
6053-14	00	1420	11	21	75.5		
6054-16	00	1420	16	21	84.4		

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Table E3 (Concluded)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6053-15	00	1420	19	21	81.8		
6054-7	00	1615	4	21	61.1	5.7	
6054-10	00	1615	11	21	74.9	19.5	
6054-12	00	1615	16	21	69.9	14.5	
6054-8	00	1615	19	21	87.2	31.8	
6053-5	03	1030	2	19	82.2		
6055-15	03	1030	9	19	98.6		
6055-10	03	1030	14	19	108.0		
6055-8	03	1030	17	19	137.0		
6054-3	03	1420	4	21	67.7		
6054-4	03	1420	11	21	77.4		
6055-5	03	1420	16	21	70.2		
6055-4	03	1420	19	21	82.0		
6054-5	03	1615	4	21	58.1	2.7	
6054-6	03	1615	11	21	66.8	11.4	
6055-14	03	1615	16	21	74.4	19	
6054-13	03	1615	16	21	71.8	16.4	
6054-19	03	1615	19	21	70.5	15.1	

(Sheet 7 of 7)

Table E4
Date: 29 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/ Silt Screen)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6059-4	13	0814	3	26	32.2		0.10
6059-7	13	0814	14	26	39.1		0.08
6059-8	13	0815	21	26	89.1		0.08
6059-5	14	0819	3	28	34.8		0.10
6058-19	14	0820	14	28	57.7		0.15
6059-1	14	0822	20	28	41.6		0.10
6059-2	15	0838	3	26	24.0		0.22
6059-6	15	0838	13	26	43.9		0.25
6059-3	15	0841	20	26	49.2		0.28
6059-12	07	0944	2	26	24.5	-21.2	
6060-2	07	0945	12	26	32.7	-13	
6060-1	07	0943	23	26	38.5	-7.2	
6059-14	08	0948	3		32.6	-13.1	
6059-15	08	0948	14		35.6	-10.1	
6059-16	08	0949	20		28.3	-17.4	
6060-17	08	0948	26		57.5	11.8	
6060-13	09	0952	2	27	33.7	-12	
6060-14	09	0951	12	27	37.1	-8.6	
6060-15	09	0953	18	27	37.5	-8.2	
6060-16	09	0954	24	27	43.6	-2.1	
6071-6	00	0900	4	22	16.0	-29.7	
6071-17	00	0900	11	22	18.1	-27.6	
6072-1	00	0900	16	22	23.3	-22.4	
6072-17	00	0900	16	22	13.5	-32.2	
6070-19	00	0900	19	22	42.7	-3	
6072-14	03	0900	4	22	14.4	-31.3	
6071-4	03	0900	11	22	22.1	-23.6	
6072-2	03	0900	16	22	30.1	-15.6	

(Sheet 1 of 8)

Table E4 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6071-5	03	0900	19	22	40.4	-5.3	
6058-15	01	0900	11	24	35.4	-10.3	
6058-10	01	0900	18	24	35.4	-10.3	
6058-18	01	0900	18	24	35.4	-10.3	
6058-16	01	0900	22	24	31.5	-14.2	
6058-11	01	0900	22	24	51.4	5.7	
6058-12	02	0920	3	25	35.0	-10.7	
6058-14	02	0920	11	25	41.2	-4.5	
6058-17	02	0920	19	25	55.8	10.1	
6058-13	02	0920	22	25	87.6	41.9	
6060-12	04	0926	1		28.8	-16.9	
6060-11	04	0926	5		33.3	-12.4	
6060-10	04	0926	7		39.3	-6.4	
6060-9	04	0926	9		40.7	-5	
6059-13	04	0946	19		34.2	-11.5	
6060-6	05	0916	3		37.1	-8.6	
6060-5	05	0917	14		38.5	-7.2	
6060-4	05	0916	20		40.0	-5.7	
6060-3	05	0918	27		50.4	4.7	
6059-18	06	0937	4		31.4	-14.3	
6059-17	06	0937	14		35.5	-10.2	
6060-7	06	0937	14		31.8	-13.9	
6059-19	06	0938	20		35.9	-9.8	
6060-8	06	0938	27		40.4	-5.3	
6061-14	10	0920	3	26	97.0	51.3	
6061-11	10	0921	12	26	117.0	71.3	
6061-10	10	0922	20	26	135.0	89.3	
6061-15	10	0923	23	26	126.0	80.3	
6061-13	11	0940	3	28	131.0	85.3	0.18
6061-18	11	0940	13	28	140.0	94.3	0.09
6061-8	11	0941	21	28	114.0	68.3	-0.05

(Sheet 2 of 8)

Table E4 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6061-12	11	0942	25	28	1,320.0	1,274.3	-0.05
6061-19	12	0947	3	27	130.0	84.3	
6061-17	12	0948	12	27	130.0	84.3	
6061-16	12	0949	20	27	126.0	80.3	
6061-9	12	0949	24	27	115.0	69.3	
6057-19	16	0716	3	25	16.5	-29.2	0.10
6058-1	16	0719	12	25	17.8	-27.9	0.08
6058-8	16	0721	19	25	33.8	-11.9	0.10
6058-2	17	0732	3	28	13.5	-32.2	-0.10
6058-9	17	0733	14	28	27.8	-17.9	0.05
6058-7	17	0734	21	28	30.7	-15.0	-0.02
6058-6	17	0735	21	28	31.9	-13.8	-0.02
6058-3	18	0745	3	25	11.3	-34.4	-0.10
6058-4	18	0746	12	25	20.5	-25.2	-0.08
6058-5	18	0748	19	25	29.0	-16.7	-0.05
Sample Period 2							
6063-2	07	1141	3	27	59.6	25	
6063-8	07	1142	12	27	50.7	16	
6063-6	07	1142	12	27	52.0	17	
6063-9	07	1143	19	27	72.6	38	
6062-16	07	1145	24	27	61.8	27	
6063-7	08	1146	3		60.7	26	
6063-3	08	1147	14		53.1	18	
6063-5	08	1147	20		56.5	22	
6063-1	08	1147	26		33.3	-2	
6062-18	09	1202	2	20	33.4	-2	
6062-14	09	1203	10	20	31.3	-4	
6062-15	09	1203	15	20	42.1	7	
6062-17	09	1203	18	20	58.9	24	
6072-3	00	1115	6	23	31.6	-3	

(Sheet 3 of 8)

Table E4 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6073-12	03	1115	6	23	31.0	-4	
6073-13	03	1115	13	23	42.4	7	
6072-6	03	1115	18	23	58.0	23	
6073-5	03	1115	21	23	71.0	36	
6064-19	01	1100	3	25	30.1	-5	
6064-17	01	1100	11	25	38.0	3	
6064-15	01	1100	19	25	31.1	-4	
6065-3	01	1100	23	25	41.3	6	
6064-18	02	1130	2	24	31.8	-3	
6064-16	02	1130	18	24	27.1	-8	
6065-1	02	1130	19	24	28.1	-7	
6065-2	02	1130	22	24	26.6	-8	
6063-17	04	1112	2	20	33.5	-2	
6063-16	04	1115	9	20	32.4	-3	
6063-14	04	1115	13	20	36.0	1	
6063-18	04	1115	16	20	48.7	14	
6063-10	05	1125	3		30.7	-4	
6063-11	05	1125	14		31.3	-4	
6063-15	05	1126	20		36.6	2	
6063-19	05	1127	26		39.8	5	
6063-13	06	1132	4		32.8	-2	
6063-12	06	1133	15		37.7	3	
6062-19	06	1134	22		37.4	2	
6063-4	06	1135	28		54.2	19	
6062-9	10	1105	3	28	27.9	-7	
6062-13	10	1106	13	28	29.8	-5	
6062-12	10	1106	21	28	33.0	-2	
6062-7	10	1107	25	28	36.6	2	
6062-2	11	1117	3	29	24.1	-11	-0.02
6062-8	11	1117	3	29	19.7	-15	-0.02

(Sheet 4 of 8)

Table E4 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6062-11	11	1118	13	29	27.9	-7	-0.10
6062-10	11	1119	22	29	33.7	-1	-0.075
6062-5	11	1130	26	29	35.4	0	-0.025
6062-6	12	1140	3	27	16.6	-18	
6062-1	12	1141	12	27	30.7	-4	
6062-3	12	1141	20	27	35.4	0	
6062-4	12	1142	24	27	37.2	2	
Sample Period 3							
6076-7	13	1420	3	26	23.1		0.12
6076-9	13	1432	12	26	22.5		0.20
6076-4	13	1432	19	26	28.0		0.12
6076-11	14	1438	3	28	21.5		0.28
6076-8	14	1439	14	28	25.9		0.32
6076-5	14	1440	21	28	31.0		0.25
6076-12	15	1443	3	26	20.9		0.40
6076-10	15	1444	12	26	21.6		0.32
6076-2	15	1445	19	26	27.0		0.25
6046-18	07	1400	3		27.6	3	
6046-13	07	1400	12		38.0	13.4	
6065-9	07	1401	12		34.0	9.4	
6046-14	07	1402	18		38.4	13.8	
6065-6	07	1403	23		37.1	12.5	
6065-7	08	1405	3		27.0	2.4	
6065-14	08	1405	14		28.4	3.8	
6046-12	08	1405	20		35.6	11	
6065-19	08	1406	26		36.3	11.7	
6065-15	09	1408	3		24.4	-0.2	
6046-11	09	1408	12		31.5	6.9	
6065-8	09	1409	18		77.2	52.6	
6046-10	09	1408	23		37.5	12.9	

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Table E4 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6071-8	00	1430	6	23	44.4	19.8	
6071-7	00	1430	13	23	64.0	39.4	
6073-6	00	1430	18	23	123.0	98.4	
6073-7	00	1430	21	23	132.0	107.4	
6071-14	03	1430	6	23	21.3	-3.3	
6073-9	03	1430	13	23	30.7	6.1	
6071-15	03	1430	18	23	15.9	-8.7	
6073-8	03	1430	21	23	32.6	8	
6070-12	01	1300	3	25	25.2	0.6	
6070-13	01	1300	11	25	47.6	23	
6070-16	01	1300	19	25	50.9	26.3	
6070-15	01	1300	23	25	50.5	25.9	
6070-17	02	1325	3	26	20.0	-4.6	
6070-18	02	1325	12	26	28.7	4.1	
6070-14	02	1325	20	26	45.8	21.2	
6070-11	02	1325	23	26	36.2	11.6	
6046-15	04	1311	3	27	43.5	18.9	
6065-16	04	1312	12	27	43.2	18.6	
6065-12	04	1311	20	27	49.2	24.6	
6065-13	04	1312	24	27	51.9	27.3	
6065-17	05	1327	3		38.5	13.9	
6065-4	05	1327	13		35.4	10.8	
6065-11	05	1328	21		32.0	7.4	
6046-16	05	1329	28		35.7	11.1	
6065-18	06	1354	4		31.6	7	
6046-17	06	1354	15		35.6	11	
6065-5	06	1355	20		34.5	9.9	
6065-10	06	1355	28		43.3	18.7	
6074-7	10	1320	3	25	13.1	-11.5	
6073-19	10	1322	11	25	16.6	-8	

(Sheet 6 of 8)

Table E4 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6073-18	10	1323	19	25	42.9	18.3	
6074-2	10	1324	23	25	43.2	18.6	
6073-15	11	1401	3	30	20.5	-4.1	0.12
6074-4	11	1407	14	30	21.6	-3.0	0.12
6074-6	11	1411	23	30	23.2	-1.4	0.13
6074-5	11	1412	27	30	23.0	-1.6	0.15
6074-3	12	1423	3	27	15.7	-8.9	
6074-1	12	1424	12	27	15.7	-8.9	
6073-17	12	1424	20	27	22.2	-2.4	
6073-16	12	1425	24	27	22.4	-2.2	
6075-14	16	1507	3	25	8.5	-16.1	0.15
6075-16	16	1508	12	25	17.7	-6.9	0.25
6075-13	16	1509	19	25	39.6	15.0	0.22
6076-6	17	1516	3	28	6.7	-17.9	-0.02
6075-19	17	1517	14	28	21.6	-3.0	0.12
6075-17	17	1518	21	28	33.5	8.9	0.12
6075-18	18	1523	3	25	12.0	-12.6	-0.05
6076-3	18	1524	12	25	21.5	-3.1	0.00
6076-1	18	1524	12	25	26.5	1.9	0.00
6075-15	18	1525	19	25	27.5	2.9	-0.05
6072-9	00	0830	4	22	15.8	-29.9	
6071-3	00	0830	11	22	20.6	-25.1	
6071-12	00	0830	16	22	33.6	-12.1	
6072-18	00	0830	19	22	20.3	-25.4	
6071-1	00	0830	19	22	22.9	-22.8	
6072-19	00	1014	4		63.7		
6072-15	00	1015	13		25.8		
6072-7	00	1015	13		30.6		
6071-9	00	1015	18		38.1		

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Table E4 (Concluded)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6072-11	00	1015	21		88.4		
6073-10	00	1017	4	22	27.9		
6072-4	00	1016	11	22	20.6		
6072-12	00	1018	16	22	26.7		
6073-14	00	1018	19	22	17.4		
6073-2	00	1600	6	23	29.4		
6073-1	00	1600	13	23	59.3		
6072-10	00	1600	18	23	574.0		
6071-16	00	1600	21	23	528.0		
6072-16	03	0830	4	22	16.8	-28.9	
6072-13	03	0830	4	22	24.6	-21.1	
6071-13	03	0830	11	22	26.1	-19.6	
6071-11	03	0830	16	22	22.7	-23	
6071-2	03	0830	19	22	40.9	-4.8	
6073-11	03	1020	19	22	108.0		
6071-10	03	1021	4	22	16.7		
6071-19	03	1024	11	22	25.2		
6072-5	03	1023	16	22	33.0		
6073-3	03	1600	6	23	22.2		
6071-18	03	1600	13	23	32.1		
6073-4	03	1600	18	23	45.8		
6072-8	03	1600	21	23	52.4		

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Table E5
Date: 30 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6076-18	13	0843	3	20	91.5		0.38
6076-14	13	0845	10	20	85.7		0.32
6076-13	13	0845	15	20	91.2		0.35
6077-2	14	0850	3	20	97.7		0.65
6076-19	14	0851	10	20	94.3		
6077-1	14	0851	10	20	101.0		0.50
6076-17	14	0851	15	20	98.8		0.46
6076-16	15	0858	3	11	102.0		0.62
6077-3	15	0900	6	11	101.0		0.62
6076-15	15	0906	8	11	114.0		0.55
6077-12	16	0803	3	20	97.5	-0.2	0.45
6077-8	16	0804	10	20	106.2	8.5	0.55
6077-5	16	0805	15	20	97.6	-0.1	0.515
6077-7	17	0812	3	20	79.8	-17.9	0.38
6077-6	17	0811	10	20	91.0	-6.7	0.42
6077-10	17	0810	15	20	103.2	5.5	0.46
6077-9	17	0811	15	20	102.5	4.8	0.46
6077-4	18	0822	3	20	84.7	-13.0	0.18
6077-11	18	0821	10	20	85.4	-12.3	0.28
Sample Period 2							
6079-12	07	1301	2	20	54.3	-16	
6079-8	07	1302	9	20	53.8	-16	
6079-18	07	1303	15	20	57.2	-13	
6079-15	07	1304	15	20	61.5	-9	
6079-19	07	1305	18	20	77.2	7	
6087-18	08	1310	2	20	50.9	-19	
6079-16	08	1312	9	20	53.8	-16	
6079-11	08	1312	15	20	63.1	-7	
6079-14	08	1315	18	20	89.1	19	

(Sheet 1 of 7)

Table E5 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6079-4	00	1300	2	19	47.9	-22	
6078-11	00	1300	9	19	49.3	-21	
6078-17	00	1300	14	19	73.3	3	
6079-7	00	1300	17	19	146.0	76	
6079-1	03	1300	2	19	34.5	-36	
6078-13	03	1300	9	19	49.4	-21	
6078-12	03	1300	14	19	60.2	-10	
6079-2	03	1300	17	19	83.0	13	
6078-8	01	1245	2	19	46.1	-24	
6078-9	01	1245	9	19	51.5	-19	
6078-10	01	1245	14	19	67.4	-3	
6078-6	01	1245	17	19	102.0	32	
6078-2	02	1300	2	19	40.5	-30	
6078-3	02	1300	9	19	46.8	-23	
6078-7	02	1300	14	19	54.2	-16	
6078-4	02	1300	14	19	57.8	-12	
6080-12	04	1239	2		53.6	-16	
6080-6	04	1239	9		55.7	-14	
6080-4	04	1242	15		70.2	0	
6080-3	04	1245	18		68.2	-2	
6080-11	05	1213	2	20	59.6	-10	
6080-7	05	1252	9	20	72.7	3	
6080-2	05	1254	14	20	91.2	21	
6080-5	05	1255	17	20	109.0	39	
6080-9	06	1257	2	20	51.8	-18	
6080-10	06	1258	9	20	58.6	-11	
6080-8	06	1258	15	20	85.4	15	
6079-10	06	1259	18	20	83.8	14	
6081-2	10	1237	2	18	53.3	-17	
6081-3	10	1238	8	18	57.3	-13	

(Sheet 2 of 7)

Table E5 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6081-4	10	1239	14	18	68.0	-2	
6081-5	10	1240	16	18	74.4	4	
6080-17	11	1250	2	20	45.0	-25	0.45
6080-18	11	1251	9	20	54.8	-15	0.50
6080-19	11	1252	15	20	31.7	-38	0.28
6081-1	11	1253	18	20	85.0	15	0.265
6080-13	12	1310	2	20	46.0	-24	
6080-14	12	1311	9	20	46.7	-23	
6080-15	12	1312	15	20	58.2	-12	
6080-16	12	1313	18	20	94.2	24	
Sample Period 3							
6081-13	07	1505	2	18	32.5	-28	
6081-17	07	1506	8	18	42.9	-17	
6081-16	07	1508	14	18	44.5	-16	
6081-14	07	1507	16	18	52.2	-8	
6081-15	08	1510	2	19	39.8	-20	
6081-10	08	1512	9	19	40.8	-19	
6082-8	08	1513	14	19	56.3	-4	
6082-5	08	1514	17	19	54.4	-6	
6081-12	09	1515	2	20	36.0	-24	
6082-9	09	1517	9	20	41.2	-19	
6082-11	09	1516	15	20	30.0	-30	
6082-7	09	1518	18	20	51.6	-8	
6087-2	00	1515	6	23	186.0	126	
6087-8	00	1515	13	23	78.5	19	
6087-6	00	1515	18	23	598.0	538	
6087-4	00	1515	18	23	1,050.0	990	
6087-3	00	1515	21	23	3,120.0	3,060	
6085-5	01	1445	2	18	31.1	-29	
6084-18	01	1445	8	18	37.8	-22	
(Sheet 3 of 7)							

Table E5 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6084-19	01	1445	14	18	62.4	2	
6085-6	01	1445	16	18	86.5	27	
6085-3	02	1500	2	19	29.7	-30	
6085-2	02	1500	9	19	42.2	-18	
6085-4	02	1500	14	19	127.0	67	
6085-1	02	1500	17	19	147.0	87	
6081-6	04	1445	2	20	38.3	-22	
6082-4	04	1446	9	20	43.0	-17	
6081-7	04	1447	15	20	39.3	-21	
6082-3	04	1448	18	20	133.0	73	
6082-6	05	1451	2	20	493.0	433	
6081-8	05	1452	9	20	50.1	-10	
6081-18	05	1452	15	20	76.1	16	
6082-1	05	1453	18	20	57.6	-2	
6081-19	06	1457	2	20	31.5	-29	
6081-11	06	1457	9	20	48.8	-11	
6081-9	06	1458	15	20	59.3	-1	
6082-2	06	1458	15	20	88.1	28	
6082-10	06	1459	17	20	56.9	-3	
6082-12	10	1445	2	18	49.5	-11	
6083-4	10	1446	8	18	39.2	-21	
6083-3	10	1447	14	18	36.0	-24	
6083-2	10	1448	16	18	50.8	-9	
6082-13	11	1453	2	20	34.6	-25	0.35
6082-14	11	1456	9	20	34.6	-25	0.435
6082-15	11	1459	15	20	58.5	-2	0.275
6083-1	11	1501	18	20	67.9	8	0.24
6082-17	12	1510	2	20	25.7	-34	
6082-19	12	1510	9	20	46.3	-14	
6082-16	12	1511	15	20	56.5	-4	

(Sheet 4 of 7)

Table E5 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6082-18	12	1511	18	20	91.8	32	
Sample Period 4							
6105-5	13	1649	3	20	42.4		0.20
6105-4	13	1651	10	20	32.4		0.15
6105-3	13	1651	15	20	36.7		0.135
6105-8	14	1655	3	20	48.2		0.22
6105-6	14	1657	10	20	44.2		0.22
6105-1	14	1658	15	20	42.6		0.225
6105-2	15	1704	3	8	46.0		
6105-11	15	1706	4	8	43.5		0.25
6105-7	15	1708	7	8	57.7		0.14
6084-8	07	1640	2	18	32.3	-11.4	
6083-19	07	1641	8	18	33.8	-9.9	
6083-16	07	1642	14	18	48.1	4.4	
6084-12	07	1643	16	18	44.2	0.5	
6084-3	08	1632	2	19	39.5	-4.2	
6083-18	08	1633	9	19	48.4	4.7	
6084-15	08	1634	14	19	52.5	8.8	
6084-11	08	1635	17	19	46.9	3.2	
6084-2	09	1625	2	17	36.0	-7.7	
6084-17	09	1626	7	17	45.0	1.3	
6084-13	09	1627	13	17	64.5	20.8	
6084-7	09	1628	15	17	53.5	9.8	
6083-9	01	1600	2	18	25.0	-18.7	
6083-12	01	1600	8	18	39.5	-4.2	
6083-6	01	1600	14	18	45.6	1.9	
6083-10	01	1600	16	18	64.9	21.2	
6083-7	02	1615	2	19	24.2	-19.5	
6083-5	02	1615	9	19	33.6	-10.1	
6083-8	02	1615	14	19	57.7	14	

(Sheet 5 of 7)

Table E5 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6083-11	02	1615	17	19	167.0	123.3	
6083-13	04	1605	2	20	34.9	-8.8	
6084-9	04	1606	9	20	40.0	-3.7	
6084-5	04	1606	15	20	45.9	2.2	
6083-17	04	1608	18	20	71.0	27.3	
6083-15	05	1615	2	19	41.9	-1.8	
6084-16	05	1616	9	19	43.8	0.1	
6084-10	05	1617	14	19	45.4	1.7	
6084-4	05	1618	17	19	51.9	8.2	
6083-14	06	1610	1		48.0	4.3	
6084-14	06	1611	6		47.2	3.5	
6084-6	06	1612	11		49.0	5.3	
6084-1	06	1613	13		48.6	4.9	
6086-11	10	1601	2	18	46.5	2.8	
6086-15	10	1601	2	18	39.4	-4.3	
6086-8	10	1602	8	18	46.9	3.2	
6086-18	10	1602	14	18	51.6	7.9	
6086-17	10	1603	16	18	86.8	43.1	
6086-14	11	1607	2	20	40.8	-2.9	0.32
6086-10	11	1608	9	20	46.2	2.5	0.285
6086-7	11	1608	15	20	116.0	72.3	0.30
6086-16	11	1609	18	20	106.0	62.3	0.21
6086-13	12	1621	2	20	42.8	-0.9	
6086-9	12	1622	9	20	45.5	1.8	
6086-6	12	1622	15	20	86.9	43.2	
6086-12	12	1623	18	20	99.4	55.7	
6105-16	16	1732	3	20	150.0	106.3	0.02
6105-15	16	1733	10	20	62.3	18.6	0.10
6105-19	16	1733	10	20	63.8	20.1	0.10
6105-13	16	1734	15	20	71.7	28.0	0.05

(Sheet 6 of 7)

Table E5 (Concluded)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6105-14	17	1724	3	20	39.9	-3.8	0.05
6105-17	17	1745	10	20	49.8	6.1	0.20
6105-18	17	1747	15	20	156.0	112.3	0.125
6105-9	18	1721	3	20	41.8	-1.9	
6105-12	18	1723	3	20	56.7	13.0	0.25
6105-10	18	1724	15	20	48.8	5.1	
6078-18	00	1130	14	19	79.8		
6078-15	00	1130	17	19	378.0		
6086-19	00	1400	6	23	34.7		
6087-5	00	1400	6	23	67.2		
6087-7	00	1400	13	23	62.8		
6087-9	00	1400	18	23	198.0		
6087-1	00	1400	21	23	3,330.0		
6078-19	03	1130	2	19	82.7		
6079-6	03	1130	9	19	99.6		
6079-5	03	1130	14	19	245.0		
6078-16	03	1130	17	19	245.0		
(Sheet 7 of 7)							

Table E6
Date: 31 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6108-17	13	0826	3	20	94.5		1.30
6108-20	13	0827	10	20	95.4		1.30
6108-15	13	0828	15	20	98.9		1.00
6108-18	14	0852	3	20	137.0		1.20
6108-16	14	0853	10	20	167.0		0.65
6108-13	14	0854	15	20	169.0		0.45
6108-19	15	0901	3	8	120.0		0.45
6108-14	15	0902	4	8	140.0		0.45
6108-12	15	0903	7	8	171.0		0.41
6109-11	01	1025	2	18	110.0	-22.5	
6109-13	01	1025	8	18	157.0	24.5	
6109-14	01	1025	14	18	143.0	10.5	
6109-15	01	1025	16	18	349.0	216.5	
6109-12	02	1045	2	19	106.0	-26.5	
6109-9	02	1045	9	19	111.0	-21.5	
6109-10	02	1045	9	19	105.0	-27.5	
6109-17	02	1045	14	19	111.0	-21.5	
6109-16	02	1045	17	19	138.0	5.5	
6112-13	04	1013	2	20	111.0	-21.5	
6112-14	04	1014	9	20	128.0	-4.5	
6112-20	04	1015	15	20	135.0	2.5	
6113-6	04	1016	18	20	136.0	3.5	
6112-12	05	1023	2	19	99.3	-33.2	
6112-15	05	1024	9	19	103.0	-29.5	
6113-1	05	1025	14	19	109.0	-23.5	
6113-7	05	1025	17	19	128.0	-4.5	
6111-9	06	1028	2	18	98.8	-33.7	
6112-16	06	1029	8	18	139.0	6.5	
6113-2	06	1029	8	18	155.0	22.5	

(Sheet 1 of 4)

Table E6 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6111-5	06	1030	14	18	119.0	-13.5	
6113-8	06	1031	16	18	141.0	8.5	
6109-4	10	1026	2	18	100.0	-32.5	
6109-8	10	1027	8	18	111.0	-21.5	
6109-6	10	1027	14	18	147.0	14.5	
6109-2	10	1027	16	18	322.0	189.5	
6109-5	11	1020	2	20	107.0	-25.5	0.52
6109-3	11	1021	9	20	130.0	-2.5	0.45
6109-7	11	1021	15	20	127.0	-5.5	0.51
6109-1	11	1022	18	20	190.0	57.5	0.48
6108-1	16	0739	3	20	24.7	-107.8	0.65
6108-5	16	0740	10	20	25.0	-107.5	0.60
6108-2	16	0742	15	20	19.3	-113.2	0.51
6108-6	17	0732	3	20	28.4	-104.1	0.68
6107-20	17	0734	10	20	27.3	-105.2	0.60
6107-19	17	0735	15	20	29.7	-102.8	0.475
6108-3	18	0749	3	22	18.5	-114.0	0.40
6108-8	18	0752	11	22	27.8	-104.7	0.435
6108-4	18	0755	17	22	62.3	-70.2	0.30
6108-7	18	0755	17	22	62.0	-70.5	0.30
Sample Period 2							
6113-9	07	1244	1	16	193.0	38	
6111-2	07	1244	1	16	170.0	15	
6113-3	07	1246	7	16	209.0	54	
6110-17	07	1246	7	16	184.0	29	
6110-11	07	1248	12	16	175.0	20	
6112-17	07	1248	12	16	246.0	91	
6111-8	07	1250	15	16	238.0	83	
6110-5	07	1250	15	16	209.0	54	
6110-6	08	1235	2	20	126.0	-29	

(Sheet 2 of 4)

Table E6 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6113-10	08	1235	2	20	140.0	-15	
6110-12	08	1235	9	20	141.0	-14	
6113-4	08	1235	9	20	202.0	47	
6110-18	08	1237	14	20	202.0	47	
6112-18	08	1238	14	20	239.0	84	
6111-7	08	1239	18	20	225.0	70	
6111-3	08	1240	18	20	286.0	131	
6111-4	09	1226	1		95.7	-59	
6111-6	09	1227	1		90.0	-65	
6110-19	09	1228	6		112.0	-43	
6112-19	09	1228	6		130.0	-25	
6113-5	09	1228	11		149.0	-6	
6110-13	09	1228	11		150.0	-5	
6113-11	09	1229	13		174.0	19	
6110-7	09	1229	13		111.0	-44	
6122-6	00*	1200	6	24	116.0	-39	
6118-17	00*	1200	13	24	131.0	-24	
6122-8	00*	1200	18	24	154.0	-1	
6118-19	00*	1200	21	24	142.0	-13	
6118-14	03*	1200	4	21	92.9	-62	
6118-20	03*	1200	11	21	122.0	-33	
6118-15	03*	1200	16	21	220.0	65	
6119-1	03*	1200	19	21	229.0	74	
6113-12	01	1210	2	18	120.0	-35	
6113-19	01	1210	8	18	191.0	36	
6113-17	01	1210	14	18	217.0	62	
6113-18	01	1210	16	18	537.0	382	
6113-13	02	1230	2	19	168.0	13	
6113-16	02	1230	9	19	191.0	36	
6113-15	02	1230	14	19	255.0	100	

(Sheet 3 of 4)

Table E6 (Concluded)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6113-14	02	1230	17	19	388.0	233	
6110-1	04	1206	2	20	82.3	-73	
6110-14	04	1207	9	20	91.6	-63	
6110-8	04	1208	15	20	101.0	-54	
6110-3	04	1209	18	20	127.0	-28	
6110-20	05	1214	3	20	108.0	-47	
6110-15	05	1215	9	20	100.0	-55	
6110-9	05	1216	15	20	116.0	-39	
6110-2	05	1217	18	20	149.0	-6	
6111-1	06	1220	2	20	87.1	-68	
6110-16	06	1220	9	20	87.5	-68	
6110-10	06	1221	9	20	134.0	-21	
6110-4	06	1228	15	20	138.0	-17	
6109-20	06	1229	18	20	162.0	7	
6112-3	10	1203	2	18	172.0	17	
6112-6	10	1203	8	18	124.0	-31	
6112-9	10	1204	14	18	131.0	-24	
6112-4	10	1204	16	18	168.0	13	
6112-11	11	1210	2	20	115.0	-40	0.62
6111-10	11	1211	9	20	136.0	-19	0.535
6112-10	11	1213	15	20	133.0	-22	0.51
6112-8	11	1216	18	20	166.0	11	0.50
6112-7	12	1237	2	20	110.0	-45	
6112-1	12	1238	9	20	145.0	-10	
6112-2	12	1238	15	20	250.0	95	
6112-5	12	1239	18	20	258.0	103	

(Sheet 4 of 4)

Table E7
Date: 31 July 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6119-4	13	1648	3	20	199.0		0.90
6119-10	13	1651	10	20	213.0		1.00
6119-6	13	1652	15	20	242.0		0.85
6119-12	14	1702	3	18	179.0		1.50
6119-3	14	1703	10	18	244.0		1.10
6119-8	14	1705	15	18	236.0		1.00
6119-9	14	1705	15	18	162.0		1.00
6119-7	15	1710	3	20	166.0		1.20
6119-5	15	1715	10	20	152.0		1.15
6119-11	15	1720	15	20	152.0		
6114-19	07	1515	2	20	393.0	198.5	
6115-5	07	1516	9	20	382.0	187.5	
6115-11	07	1517	15	20	394.0	199.5	
6115-17	07	1518	17	20	382.0	187.5	
6115-18	08	1508	2	20	276.0	81.5	
6115-12	08	1509	9	20	344.0	149.5	
6115-6	08	1510	15	20	371.0	176.5	
6114-20	08	1510	17	20	382.0	187.5	
6115-13	09	1502	2	19	250.0	55.5	
6115-19	09	1503	9	19	388.0	193.5	
6115-7	09	1504	14	19	424.0	229.5	
6115-1	09	1506	17	19	398.0	203.5	
6117-1	00*	1530	6	23	235.0	40.5	
6116-19	00*	1530	13	23	287.0	92.5	
6116-20	00*	1530	18	23	333.0	138.5	
6117-2	00*	1530	18	23	316.0	121.5	
6116-17	00*	1530	21	23	364.0	169.5	
6116-18	03*	1530	6	23	316.0	121.5	
6116-16	03*	1530	13	23	352.0	157.5	

(Sheet 1 of 3)

Table E7 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6116-14	03*	1530	18	23	456.0	261.5	
6135-14	03*	1530	18	23	534.0	339.5	
6116-13	03*	1530	18	23	279.0	84.5	
6116-15	03*	1530	21	23	560.0	365.5	
6117-17	01	1500	2	18	291.0	96.5	
6117-18	01	1500	14	18	323.0	128.5	
6117-19	01	1500	16	18	367.0	172.5	
6118-1	02	1520	2	19	296.0	101.5	
6118-2	02	1520	9	19	297.0	102.5	
6118-3	02	1520	14	19	313.0	118.5	
6118-4	02	1520	17	19	592.0	397.5	
6114-16	04	1518	2	20	394.0	199.5	
6115-2	04	1509	9	20	313.0	118.5	
6115-8	04	1521	15	20	270.0	75.5	
6115-15	05	1525	2	19	237.0	42.5	
6115-9	05	1526	9	19	226.0	31.5	
6115-3	05	1527	14	19	283.0	88.5	
6115-14	05	1522	17	19	305.0	110.5	
6114-17	05	1528	17	19	305.0	110.5	
6115-16	06	1531	2	19	276.0	81.5	
6115-10	06	1532	9	19	323.0	128.5	
6115-4	06	1532	14	19	376.0	181.5	
6114-18	06	1533	16	19	447.0	252.5	
6116-3	10	1455	2	18	255.0	60.5	
6116-6	10	1456	8	18	306.0	111.5	
6116-9	10	1456	14	18	375.0	180.5	
6116-12	10	1457	16	18	350.0	155.5	
6116-2	11	1505	2	20	627.0	432.5	0.85
6116-5	11	1506	9	20	683.0	488.5	0.95
6116-8	11	1507	15	20	749.0	554.5	1.00

(Sheet 2 of 3)

Table E7 (Concluded)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6116-11	11	1507	15	20	611.0	416.5	1.00
6116-1	11	1508	18	20	715.0	520.5	0.80
6116-4	12	1524	2	20	234.0	39.5	
6116-7	12	1525	9	20	281.0	86.5	
6116-10	12	1526	15	20	326.0	131.5	
6115-20	12	1527	18	20	366.0	171.5	
6118-8	16	1551	3	20	264.0	69.5	
6118-10	16	1555	10	20	228.0	33.5	
6118-7	16	1558	15	20	261.0	66.5	
6118-13	17	1601	3	20	220.0	25.5	
6118-12	17	1602	8	20	265.0	70.5	
6118-5	17	1605	11	20	282.0	87.5	
6118-9	18	1620	3	20	228.0	33.5	
6118-11	18	1622	5	20	261.0	66.5	
6118-6	18	1625	8	20	231.0	36.5	
6122-7	00*	1630	6	23	172.0	-22.5	
6118-16	00*	1630	13	23	197.0	2.5	
6122-5	00*	1630	18	23	210.0	15.5	
6118-18	00*	1630	21	23	199.0	4.5	
6119-2	03*	1630	6	23	163.0	-31.5	
6122-3	03*	1630	13	23	221.0	26.5	
6122-4	03*	1630	21	23	343.0	148.5	

(Sheet 3 of 3)

Table E8
DATE: 01 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6089-5	13	0822	3	22	122.0		0.65
6089-7	13	0824	11	22	144.0		0.775
6090-3	13	0825	17	22	160.0		0.785
6089-3	14	0830	3	20	160.0		0.55
6089-4	14	0832	10	20	154.0		0.85
6089-6	14	0835	15	20	144.0		0.75
6089-1	15	0838	3	8	164.0		0.80
6089-2	15	0840	6	8	163.0		0.75
6090-9	15	0845	8	8	156.0		0.55
6091-4	07	0947	2	19	71.3	-80.5	
6091-5	07	0948	9	19	70.7	-81.1	
6091-6	07	0950	14	19	101.0	-50.8	
6091-7	07	0952	17	19	110.0	-41.8	
6091-8	08	0940	2	20	114.0	-37.8	
6091-9	08	0942	9	20	115.0	-36.8	
6091-10	08	0941	15	20	135.0	-16.8	
6091-11	08	0945	18	20	117.0	-34.8	
6091-15	09	0936	1	13	126.0	-25.8	
6091-14	09	0937	6	13	97.4	-54.4	
6091-13	09	0938	10	13	131.0	-20.8	
6091-12	09	0959	11	13	1,320.0	1,168.2	
6101-16	00	1000	8	25	97.1	-54.7	
6102-7	00	1000	15	25	95.2	-56.6	
6101-17	00	1000	20	25	89.9	-61.9	
6102-14	00	1000	23	25	120.0	-31.8	
6103-6	03	1000	2	19	87.3	-64.5	
6101-19	03	1000	9	19	101.0	-50.8	
6103-1	03	1000	14	19	159.0	7.2	
6102-1	03	1000	17	19	187.0	35.2	

(Sheet 1 of 8)

Table E8 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6089-8	01	0900	2	19	104.0	-47.8	
6089-9	01	0900	9	19	138.0	-13.8	
6089-15	01	0900	14	19	177.0	25.2	
6089-13	01	0900	17	19	177.0	25.2	
6089-14	02	0920	2	18	120.0	-31.8	
6089-16	02	0920	8	18	143.0	-8.8	
6089-11	02	0920	14	18	130.0	-21.8	
6089-10	02	0920	14	18	147.0	-4.8	
6089-12	02	0920	16	18	142.0	-9.8	
6092-5	04	0917	2	20	113.0	-38.8	
6092-6	04	0918	9	20	94.1	-57.7	
6092-7	04	0919	15	20	106.0	-45.8	
6092-8	04	0920	18	20	122.0	-29.8	
6092-2	05	0923	2	20	113.0	-38.8	
6092-1	05	0924	9	20	103.0	-48.8	
6092-3	05	0925	15	20	125.0	-26.8	
6092-4	05	0926	18	20	136.0	-15.8	
6091-16	06	0930	2	20	126.0	-25.8	
6091-17	06	0931	9	20	130.0	-21.8	
6091-3	06	0932	9	20	115.0	-36.8	
6091-19	06	0932	15	20	130.0	-21.8	
6091-18	06	0933	18	20	140.0	-11.8	
6090-18	10	0912	2	18	100.0	-51.8	
6090-12	10	0913	8	18	74.0	-77.8	
6090-6	10	0914	14	18	148.0	-3.8	
6089-19	10	0914	16	18	154.0	2.2	
6090-17	11	0917	2	20	121.0	-30.8	0.60
6090-11	11	0917	9	20	126.0	-25.8	0.65
6090-5	11	0918	15	20	142.0	-9.8	0.575
6089-18	11	0918	18	20	157.0	5.2	0.45

(Sheet 2 of 8)

Table E8 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6090-16	12	0931	2	20	127.0	-24.8	
6090-10	12	0931	9	20	125.0	-26.8	
6090-4	12	0932	15	20	128.0	-23.8	
6089-17	12	0932	18	20	126.0	-25.8	
6090-2	16	0747	3	20	161.0	9.2	0.65
6090-1	16	0749	10	20	161.0	9.2	0.60
6090-15	16	0750	15	20	166.0	14.2	0.51
6090-19	17	0756	3	20	122.0	-29.8	0.68
6090-13	17	0751	10	20	136.0	-15.8	0.60
6090-7	17	0758	10	20	134.0	-17.8	0.60
6090-8	17	0759	15	20	139.0	-12.8	0.475
6091-2	18	0803	3	22	106.0	-45.8	0.40
6091-1	18	0809	11	22	178.0	26.2	0.435
6090-14	18	0811	17	22	155.0	3.2	0.30
Sample Period 2							
6095-16	07	1229	2	19	80.0	-10	
6095-18	07	1230	9	19	73.0	-17	
6095-3	07	1231	14	19	72.4	-18	
6095-4	07	1232	17	19	57.1	-33	
6095-6	08	1236	2	20	46.4	-44	
6095-7	08	1237	9	20	57.4	-33	
6095-5	08	1237	9	20	83.7	-6	
6095-13	08	1238	15	20	71.3	-19	
6095-15	08	1239	18	20	78.0	-12	
6095-8	09	1242	2	20	53.6	-36	
6095-10	09	1243	9	20	63.9	-26	
6094-10	09	1244	15	20	58.9	-31	
6094-11	09	1245	18	20	84.3	-6	
6102-18	00	1200	8	25	57.4	-33	
6103-4	00	1200	15	25	73.5	-17	

(Sheet 3 of 8)

Table E8 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6101-12	00	1200	20	25	72.2	-18	
6101-11	00	1200	23	25	70.8	-19	
6094-13	03*	1200	2	19	52.1	-38	
6094-15	03*	1200	9	19	62.7	-27	
6094-16	03*	1200	14	19	92.0	2	
6094-14	03*	1200	17	19	110.0	20	
6094-2	01	1200	2	18	59.2	-31	
6094-1	01	1200	8	18	55.6	-34	
6094-18	01	1200	14	18	91.9	2	
6093-18	01	1200	16	18	74.2	-16	
6094-19	02	1220	2	19	50.0	-40	
6095-1	02	1220	9	19	81.9	-8	
6094-17	02	1220	14	19	95.7	6	
6093-19	02	1200	17	19	76.8	-13	
6096-1	04	1208	2	20	71.4	-19	
6095-19	04	1207	9	20	85.7	-4	
6096-2	04	1206	15	20	99.6	10	
6095-17	04	1205	18	20	103.0	13	
6096-3	05	1212	2	20	57.2	-33	
6096-4	05	1213	9	20	66.4	-24	
6095-11	05	1214	15	20	92.7	3	
6095-14	05	1215	18	20	175.0	85	
6095-2	06	1221	2	20	49.2	-41	
6095-12	06	1222	9	20	57.6	-32	
6094-12	06	1223	15	20	54.7	-35	
6095-9	06	1234	18	20	61.2	-9	
6093-8	10	1210	2	20	71.2	-9	
6093-10	10	1210	9	20	80.0	-10	
6093-4	10	1211	15	20	80.6	-9	
6096-15	10	1211	18	20	93.6	4	

(Sheet 4 of 8)

Table E8 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6093-5	11	1216	2	20	88.3	-2	0.62
6093-9	11	1218	9	20	94.1	4	0.535
6093-6	11	1220	15	20	73.1	-17	0.51
6093-3	11	1222	18	20	83.2	-7	0.50
6093-1	12	1235	2	20	67.3	-23	
6093-2	12	1235	9	20	69.4	-21	
6092-19	12	1236	15	20	76.1	-14	
6093-7	12	1236	18	20	74.5	-16	
			Sample Period 3				
6103-18	13	1615	3	20	17.4		0.50
6103-15	13	1617	10	20	37.9		0.60
6103-17	13	1618	15	20	44.4		0.38
6104-5	14	1628	3	16	36.8		0.65
6104-14	14	1629	8	16	37.6		0.65
6104-10	14	1630	12	16	50.8		0.50
6104-12	15	1638	3	10	24.8		0.50
6104-6	15	1636	5	10	28.5		0.70
6104-11	15	1637	8	10	27.3		0.60
6098-18	07	1604	2	18	47.2	13.3	
6098-19	07	1605	8	18	42.4	8.5	
6099-1	07	1606	14	18	55.0	21.1	
6099-2	07	1607	16	18	52.8	18.9	
6098-14	08	1558	2	20	47.6	13.7	
6098-3	08	1543	9	20	130.0	96.1	
6098-15	08	1559	9	20	54.8	20.9	
6098-16	08	1600	15	20	56.0	22.1	
6098-17	08	1601	18	20	56.7	22.8	
6098-13	09	1555	1		48.0	14.1	
6098-12	09	1556	6		40.3	6.4	
6098-11	09	1557	11		50.7	16.8	

(Sheet 5 of 8)

Table E8 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6098-10	09	1557	13		51.8	17.9	
6101-7	00	1610	9	26	26.4	-7.5	
6101-8	00	1610	16	26	140.0	106.1	
6102-4	00	1610	21	26	54.5	20.6	
6102-10	00	1610	24	26	695.0	661.1	
6102-9	03	1610	6	23	28.1	-5.8	
6102-16	03	1610	13	23	44.7	10.8	
6101-4	03	1610	18	23	124.0	90.1	
6102-3	03	1610	21	23	314.0	280.1	
6100-16	03	1610	21	23	188.0	154.1	
6097-12	01	1530	2	18	59.6	25.7	
6097-11	01	1530	8	18	71.9	38	
6097-10	01	1530	14	18	111.0	77.1	
6097-9	01	1530	16	18	146.0	112.1	
6097-16	02	1545	2	19	41.0	7.1	
6097-15	02	1545	9	19	54.0	20.1	
6097-14	02	1545	14	19	57.0	23.1	
6097-13	02	1545	17	19	90.6	56.7	
6098-1	04	1533	2	20	57.9	24	
6097-19	04	1533	9	20	59.5	25.6	
6097-17	04	1534	15	20	112.0	78.1	
6097-18	04	1535	18	20	62.4	28.5	
6098-5	05	1542	2	20	46.8	12.9	
6098-4	05	1544	9	20	53.5	19.6	
6098-2	05	1545	18	20	145.0	111.1	
6098-6	06	1550	2	12	60.6	26.7	
6098-7	06	1551	7	12	52.8	18.9	
6098-9	06	1546	9	12	53.2	19.3	
6098-8	06	1547	11	12	59.2	25.3	
6099-12	10	1531	2	20	46.8	12.9	

(Sheet 6 of 8)

Table E8 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6099-13	10	1531	9	20	59.6	25.7	
6099-14	10	1532	15	20	74.5	40.6	
6099-15	10	1532	15	20	82.5	48.6	
6099-8	10	1533	18	20	107.0	73.1	
6099-9	11	1537	2	20	38.4	4.5	0.42
6099-10	11	1537	9	20	60.8	26.9	0.45
6099-11	11	1538	15	20	88.6	54.7	0.45
6099-4	11	1538	18	20	80.4	46.5	0.20
6099-5	12	1553	2	20	42.0	8.1	
6099-6	12	1554	9	20	45.6	11.7	
6099-7	12	1554	15	20	59.3	25.4	
6099-3	12	1555	18	20	76.8	42.9	
6103-19	16	1652	3	20	31.8	-2.1	0.52
6104-9	16	1653	10	20	49.4	15.5	0.45
6104-1	16	1654	15	20	111.0	77.1	0.415
6104-2	17	1701	3	20	106.0	72.1	0.50
6104-8	17	1702	10	20	179.0	145.1	0.40
6104-13	17	1703	15	20	113.0	79.1	0.46
6103-16	18	1701	3	20	58.1	24.2	0.40
6104-4	18	1711	10	20	70.4	36.5	0.38
6104-7	18	1712	15	20	80.8	46.9	0.40
6104-3	18	1712	15	20	82.8	48.9	0.40
6101-2	00	1100	8	25	56.0		
6102-13	00	1100	15	25	69.7		
6101-15	00	1100	20	25	70.8		
6102-6	00	1100	23	25	189.0		
6101-13	00	1100	23	25	155.0		
6100-18	00	1515	9	26	55.6		
6102-17	00	1515	16	26	47.7		

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Table E8 (Concluded)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6102-12	00	1515	21	26	64.2		
6101-6	00	1515	21	26	43.8		
6103-3	00	1515	24	26	132.0		
6101-3	00	1645	9	26	33.8	-0.1	
6102-8	00	1645	16	26	53.7	19.8	
6101-5	00	1645	21	26	74.3	40.4	
6102-2	00	1645	24	26	606.0	572.1	
6102-19	03*	1100	2	19	72.6		
6101-18	03*	1100	9	19	84.6		
6103-5	03*	1100	14	19	146.0		
6101-14	03*	1100	17	19	190.0		
6102-5	03*	1515	6	23	52.6		
6101-10	03*	1515	13	23	145.0		
6102-11	03*	1515	18	23	192.0		
6101-9	03*	1515	21	23	451.0		
6101-1	03*	1645	6	23	78.5	44.6	
6103-2	03*	1645	13	23	138.0	104.1	
6100-19	03*	1645	18	23	90.0	56.1	
6102-15	03*	1645	21	23	107.0	73.1	

(Sheet 8 of 8)

Table E9
Date: 03 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6124-6	13	0833	3	20	14.4		0.15
6123-13	13	0834	10	20	27.2		0.20
6124-5	13	0835	15	20	40.8		0.125
6123-16	14	0845	3	16	9.6		0.20
6123-14	14	0846	8	16	15.3		0.32
6124-3	14	0847	12	16	51.8		
6124-4	14	0847	12	16	30.8		0.08
6123-15	15	0852	3	8	<8.7		
6123-17	15	0852	4	8	26.0		0.20
6123-19	15	0852	7	8	40.0		0.065
6125-8	07	1019	2	20	15.2	-13.2	
6125-7	07	1020	9	20	13.2	-15.2	
6125-4	07	1021	15	20	28.0	-0.4	
6125-11	07	1022	18	20	208.0	179.6	
6124-20	08	1014	2	20	13.2	-15.2	
6125-2	08	1015	9	20	20.8	-7.6	
6125-5	08	1016	15	20	26.8	-1.6	
6125-3	08	1017	18	20	26.4	-2	
6124-12	09	1009	2	19	16.4	-12	
6124-17	09	1010	9	19	24.6	-3.8	
6125-9	09	1011	9	19	29.2	0.8	
6124-15	09	1012	14	19	33.5	5.1	
6124-14	09	1013	17	19	35.9	7.5	
6134-4	00*	0920	8	25	136.0	107.6	
6134-7	00*	0920	15	25	316.0	287.6	
6134-1	00*	0920	20	25	595.0	566.6	
6133-20	00*	0920	23	25	2,000.0	1,971.6	
6133-19	03	0920	8	25	80.1	51.7	
6134-13	03	0920	15	25	158.0	129.6	

(Sheet 1 of 8)

Table E9 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6134-6	03	0920	20	25	272.0	243.6	
6134-14	03	0920	23	25	443.0	414.6	
6123-1	01	0930	2	23	6.8	-21.6	
6123-3	01	0930	10	23	116.0	87.6	
6123-2	01	0930	17	23	180.0	151.6	
6122-19	01	0930	21	23	264.0	235.6	
6123-4	02	0945	2	19	19.9	-8.5	
6123-5	02	0945	9	19	20.1	-8.3	
6123-7	02	0945	14	19	83.2	54.8	
6122-20	02	0945	17	19	210.0	181.6	
6123-6	02	0945	17	19	183.0	154.6	
6124-8	04	0949	3	20	18.0	-10.4	
6124-13	04	0950	9	20	17.0	-11.4	
6124-10	04	0951	15	20	23.7	-4.7	
6125-1	04	0952	18	20	27.6	-0.8	
6125-10	05	0957	2	18	29.6	1.2	
6124-11	05	1000	8	18	24.8	-3.6	
6125-6	05	1001	14	18	79.2	50.8	
6124-16	05	1002	16	18	114.0	85.6	
6124-9	06	0954	3		17.6	-10.8	
6124-19	06	0957	6		19.2	-9.2	
6124-7	06	0954	11		43.5	15.1	
6124-18	06	0957	13		508.0	479.6	
6126-3	10	0947	2	18	26.4	-2	
6125-16	10	0948	8	18	45.6	17.2	
6125-12	10	0948	14	18	44.4	16	
6125-14	10	0949	16	18	34.8	6.4	
6125-20	11	0955	2	20	10.4	-18.0	0.25
6125-19	11	0956	9	20	38.4	10.0	0.10
6125-13	11	0956	15	20	60.4	32.0	0.15

(Sheet 2 of 8)

Table E9 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6125-17	11	0957	18	20	50.4	22.0	0.12
6126-2	12	1013	2	20	13.6	-14.8	
6126-1	12	1014	9	20	28.0	-0.4	
6125-15	12	1014	15	20	56.0	27.6	
6125-18	12	1015	18	20	54.4	26	
6123-12	16	0803	3	20	26.0	-2.4	0.30
6123-20	16	0804	10	20	48.8	20.4	0.28
6124-1	16	0805	15	20	42.9	14.5	0.16
6123-9	17	0811	3	20	21.1	-7.3	0.30
6123-8	17	0812	10	20	28.0	-0.4	0.22
6124-2	17	0814	15	20	38.3	9.9	1.10
6123-11	18	0820	3	20	25.0	-3.4	0.20
6123-10	18	0821	10	20	33.6	5.2	0.02
6123-18	18	0823	10	20	36.4	8.0	0.02
Sample Period 2							
6127-3	07	1240	2	20	16.1	-4	
6126-19	07	1241	9	20	17.2	-3	
6126-11	07	1242	15	20	19.2	-1	
6126-17	07	1243	18	20	20.8	1	
6126-18	08	1232	2	20	15.2	-5	
6127-8	08	1233	9	20	19.6	0	
6127-7	08	1234	15	20	28.3	8	
6127-6	08	1235	18	20	37.4	17	
6127-11	09	1207	1		14.6	-5	
6126-6	09	1208	7		15.2	-5	
6127-10	09	1209	11		40.8	21	
6127-9	09	1210	13		49.6	30	
6132-9	00	1200	6	23	135.0	115	
6133-7	00	1200	13	23	156.0	136	
6133-6	00	1200	18	23	316.0	296	

(Sheet 3 of 8)

Table E9 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6132-08	00	1200	21	23	1,400	138	
6132-5	03	1200	6	23	28.7	9	
6136-5	03	1200	13	23	81.8	62	
6133-2	03	1200	18	23	208.0	188	
6133-1	03	1200	21	23	683.0	663	
6136-6	03	1200	21	23	182.0	162	
6128-18	01	1200	2	23	<10.6		
6128-20	01	1200	2	23	167.0	147	
6129-3	01	1200	10	23	<10.6		
6128-17	01	1200	17	23	109.0	89	
6128-19	02	1230	2	19	<10.9		
6129-1	02	1230	9	19	<25.0		
6129-2	02	1230	14	19	42.8	23	
6129-4	02	1230	17	19	89.1	69	
6126-15	04	1215	2	20	13.2	-7	
6126-5	04	1216	9	20	13.2	-7	
6126-12	04	1217	15	20	41.2	21	
6126-7	04	1218	18	20	91.6	72	
6126-14	05	1225	2	20	30.4	10	
6126-20	05	1226	9	20	75.6	56	
6127-2	05	1227	15	20	77.7	58	
6127-5	05	1228	18	20	137.0	117	
6127-4	06	1219	2	20	15.3	-5	
6127-1	06	1220	9	20	16.6	-3	
6126-4	06	1220	9	20	26.4	6	
6126-16	06	1221	15	20	51.6	32	
6126-13	06	1222	18	20	284.0	264	
6126-9	10	1205	2	18	26.4	6	
6127-20	10	1206	8	18	37.2	17	
6127-19	10	1207	14	18	21.4	1	

(Sheet 4 of 8)

Table E9 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6127-15	10	1207	16	18	80.0	60	
6126-10	11	1215	2	20	24.4	4	0.18
6127-18	11	1217	9	20	21.4	1	0.25
6127-16	11	1222	15	20	82.4	62	0.20
6127-14	11	1223	18	23	68.8	49	0.12
6127-17	12	1235	2	20	30.8	11	
6126-18	12	1236	9	20	26.0	6	
6127-12	12	1237	15	20	72.4	52.	
6127-13	12	1238	18	20	94.3	74	
Sample Period 3							
6136-20	13	1652	3	18	12.0		0.05
6136-17	13	1653	10	18	15.3		0.15
6136-18	13	1657	15	18	21.8		0.20
6137-2	14	1659	3	16	10.3		0.20
6137-1	14	1701	8	16	22.1		0.25
6136-19	14	1702	12	16	20.0		0.30
6137-3	15	1706	3	10	11.3		0.00
6137-5	15	1707	5	10	17.3		0.05
6137-4	15	1708	7	10	12.2		0.125
6137-13	07	1543	2	17	11.1	-4.7	
6137-12	07	1542	9	17	12.4	-3.4	
6137-11	07	1541	13	17	16.0	0.2	
6137-10	07	1540	15	17	20.3	4.5	
6137-14	08	1535	2	20	14.0	-1.8	
6137-16	08	1536	9	20	16.7	0.9	
6137-15	08	1537	15	20	20.7	4.9	
6137-17	08	1538	18	20	32.0	16.2	
6138-1	09	1530	0	18	15.6	-0.2	
6137-20	09	1531	8	18	14.8	-1	
6137-19	09	1532	14	18	19.7	3.9	

(Sheet 5 of 8)

Table E9 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6137-18	09	1532	16	18	21.7	5.9	
6136-1	00	1500	6	24	36.8	21	
6136-2	00	1500	13	24	80.5	64.7	
6136-3	00	1500	18	24	250.0	234.2	
6132-10	00	1500	21	24	1,260.0	1,244.2	
6131-14	03	1500	6	23	25.7	9.9	
6131-15	03	1500	13	23	34.2	18.4	
6132-3	03	1500	18	23	113.0	97.2	
6131-9	01	1500	9	19	23.2	7.4	
6131-10	01	1500	14	19	14.0	-1.8	
6131-11	01	1500	17	19	23.7	7.9	
6131-16	02	1520	2	19	15.4	-0.4	
6131-17	02	1520	09	19	<10.7		
6131-12	02	152	14	19	<10.9		
6131-13	02	1520	17	19	12.5	-3.3	
6138-13	04	1511	2	20	14.1	-1.7	
6138-12	04	1512	9	20	15.1	-0.7	
6138-11	04	1513	18	20	25.8	10	
6138-10	04	1515	18	20	38.2	22.4	
6138-2	05	1525	9	20	49.0	33.2	
6138-3	05	1526	9	20	54.9	39.1	
6138-4	05	1527	15	20	69.7	53.9	
6138-5	05	1527	18	20	65.3	49.5	
6138-9	06	1519	2	20	58.8	43	
6138-8	06	1520	9	20	22.2	6.4	
6138-6	06	1522	15	20	391.0	375.2	
6138-7	06	1523	18	20	297.0	281.2	
6133-8	10	1510	2	18	19.6	3.8	
6133-12	10	1511	8	18	43.8	28	
6127-19	10	1512	14	18	97.3	81.5	

(Sheet 6 of 8)

Table E9 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6133-16	10	1512	16	18	111.0	95.2	
6133-5	10	1512	16	18	112.0	96.2	
6133-10	11	1514	2	24	22.0	6.2	-0.15
6133-13	11	1515	9	20	62.2	46.4	0.065
6133-9	11	1516	15	20	97.0	81.2	0.165
6133-14	11	1516	18	20	98.8	83.0	0.05
6133-4	12	1526	2	20	20.0	4.2	
6133-15	12	1527	9	20	29.2	13.4	
6133-11	12	1528	15	20	88.2	72.4	
6133-17	12	1528	18	20	96.4	80.6	
6137-9	16	1559	3	20	33.3	17.5	0.10
6135-7	16	1600	9	20	65.7	49.9	0.035
6135-8	16	1600	15	20	68.0	52.2	0.075
6137-8	17	1613	3	20	30.7	14.9	-0.10
6137-6	17	1614	10	20	44.3	28.5	0.10
6135-6	17	1615	15	20	45.9	30.1	0.125
6135-3	17	1616	15	20	66.7	50.9	0.125
6135-4	18	1624	3	20	22.4	6.6	-0.05
6135-5	18	1624	10	20	39.5	23.7	0.02
6137-7	18	1625	15	20	23.3	7.5	0.11
6134-2	00	1040	9	23	197.0		
6134-12	00	1040	13	23	73.6		
6134-9	00	1040	18	23	378.0		
6134-11	00	1040	21	23	1,900.0		
6133-18	00	1040	21	23	1,760.0		
6131-18	00	1345	8	24	130.0		
6132-11	00	1345	15	24	213.0		
6132-17	00	1345	15	24	187.0		
6132-4	00	1345	20	24	1,340.0		
6132-18	00	1345	23	24	1,980.0		
							(Sheet 7 of 8)

Table E9 (Concluded)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6132-2	00	1430	6	24	59.8	44	
6132-16	00	1430	13	24	159.0	143.2	
6132-1	00	1430	18	24	302.0	286.2	
6132-15	00	1430	21	24	1,160.0	1,144	
6134-3	03	1040	6	23	35.3		
6134-8	03	1040	13	23	83.8		
6134-10	03	1040	18	23	122.0		
6134-5	03	1040	21	23	604.0		
6132-6	03	1345	8	25	28.6		
6132-19	03	1345	15	25	174.0		
6132-7	03	1345	20	25	334.0		
6132-20	03	1345	23	25	952.0		
6132-13	03	1430	6	23	76.0	60.2	
6131-19	03	1430	13	23	84.6	68.8	
6132-12	03	1430	18	23	278.0	262.2	
6132-14	03	1430	21	23	666.0	650.2	
6131-20	03	1430	21	23	1,090.0	1,074.2	

(Sheet 8 of 8)

Table E10
Date: 04 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6140-11	13	0920	3	20	30.3		0.05
6140-12	13	0921	10	20	36.3		
6140-10	13	0921	10	20	37.7		0.05
6140-9	13	0922	15	20	44.7		0.02
6140-8	14	0928	3	18	31.8		0.10
6140-6	14	0919	9	18	34.0		0.10
6140-7	14	0930	14	18	48.0		0.00
6140-4	15	0940	3	10	26.0		0.38
6140-5	15	0941	5	10	20.5		0.40
6140-3	15	0942	7	10	31.0		0.42
6141-15	07	1034	2	20	33.3	-0.7	
6142-16	07	1035	9	20	41.4	7.4	
6141-16	07	1036	15	20	394.0	360	
6142-15	07	1036	18	20	48.3	14.3	
6141-17	08	1028	2	20	35.3	1.3	
6142-12	08	1029	9	20	390.0	356	
6141-18	08	1029	15	20	45.8	11.8	
6142-14	08	1030	18	20	45.6	11.6	
6141-19	09	1023	2	17	41.3	7.3	
6142-5	09	1023	7	17	44.7	10.7	
6142-8	09	1023	13	17	45.7	11.7	
6142-13	09	1024	15	17	44.3	10.3	
6144-7	00	1030	6	25	194.0	160	
6144-9	00	1030	13	25	289.0	255	
6144-8	00	1030	18	25	1,260.0	1,226	
6143-8	00	1030	21	25	11,160.0	11,156	
6143-10	03	1030	6	23	92.0	58	
6144-6	03	1030	13	23	56.3	22.3	
6143-19	03	1030	18	23	180.0	146	

(Sheet 1 of 8)

Table E10 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6143-11	03	1030	21	23	892.0	858	
6142-17	01	0900	2	19	29.5	-4.5	
6142-19	01	0900	9	19	45.1	11.1	
6142-20	01	0900	14	19	58.1	24.1	
6143-2	01	0900	17	19	63.5	29.5	
6143-1	01	0900	17	19	57.6	23.6	
6143-3	02	0925	2	19	36.8	2.8	
6153-2	02	0925	9	19	30.5	-3.5	
6143-4	02	0925	14	19	37.4	3.4	
6142-18	02	0925	17	19	46.6	12.6	
6141-1	04	1007	2	20	31.5	-2.5	
6142-9	04	1008	9	20	32.1	-1.9	
6142-6	04	1009	15	20	33.3	-0.7	
6140-20	04	1010	18	20	7.3	-26.7	
6141-20	05	1016	2	17	28.4	-5.6	
6142-4	05	1017	7	17	42.9	8.9	
6142-7	05	1018	13	17	44.6	10.6	
6142-11	05	1018	13	17	46.3	12.3	
6141-7	05	1019	15	17	59.3	25.3	
6142-10	06	1011	2	17	24.4	-9.6	
6141-6	06	1012	7	17	29.5	-4.5	
6142-3	06	1013	13	17	34.9	0.9	
6142-1	06	1014	15	17	30.3	-3.7	
6141-8	10	0953	2	18	33.0	-1	
6141-10	10	0954	8	18	40.5	6.5	
6141-9	10	0954	14	18	59.3	25.3	
6141-2	10	0955	16	18	65.7	31.7	
6141-12	11	0957	2	20	26.4	-7.6	0.50
6141-13	11	0958	9	20	43.0	9.0	0.575
6141-14	11	0958	15	20	55.2	21.2	0.50

(Sheet 2 of 8)

Table E10 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6141-11	11	0959	18	20	68.6	34.6	0.40
6141-4	12	1010	2	20	19.1	-14.9	
6141-5	12	1011	9	20	44.7	10.7	
6141-2	12	1011	15	20	43.6	9.6	
6141-3	12	1011	18	20	48.0	14	
6139-12	16	0849	3	20	22.6	-11.4	0.08
6139-13	16	0850	10	20	52.7	18.7	0.18
6139-14	16	0851	15	20	20.5	-13.5	0.14
6153-1	17	0859	3	20	24.7	-9.3	0.00
6139-16	17	0901	10	20	13.7	-20.3	0.00
6139-15	17	0902	15	20	19.3	-14.7	0.00
6139-18	18	0906	3	20	22.7	-11.3	-0.10
6139-19	18	0907	10	20	24.0	-10.0	0.02
6139-17	18	0910	15	20	27.7	-6.3	0.025
Sample Period 2							
6145-10	07	1250	2	20	88.1	-11.9	
6145-4	07	1251	9	20	79.9	-20.1	
6145-8	07	1251	9	20	103.0	3	
6145-5	07	1252	15	20	114.0	14	
6145-9	07	1253	18	20	98.0	-2	
6145-11	08	1246	2	20	91.9	-8.1	
6145-6	08	1247	9	20	93.0	-7	
6145-13	08	1248	15	20	97.5	-2.5	
6145-7	08	1249	18	20	95.5	-4.5	
6145-12	09	1241	2		84.8	-15.2	
6145-14	09	1242	6		76.8	-23.2	
6145-15	09	1243	11		104.0	4	
6145-16	09	1244	13		122.0	22	
6144-4	00*	1200	8	25	39.5	-60.5	
6144-2	00*	1200	15	25	7.6	-92.4	

(Sheet 3 of 8)

Table E10 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6143-18	00*	1200	20	25	85.9	-14.1	
6143-5	00*	1200	20	25	74.3	-25.7	
6144-3	00*	1200	23	25	76.2	-23.8	
6153-3	03*	1200	8	25	35.9	-64.1	
6143-20	03*	1200	15	25	38.6	-61.4	
6143-6	03*	1200	20	25	53.8	-46.2	
6144-1	03*	1200	23	25	179.0	79	
6146-17	01	1200	2	19	63.1	-36.9	
6146-12	01	1200	9	19	80.9	-19.1	
6146-13	01	1200	14	19	638.0	538	
6146-16	01	1200	17	19	106.0	6	
6146-10	02	1230	2	19	81.7	-18.3	
6146-14	02	1230	9	19	58.3	-41.7	
6146-15	02	1230	14	19	81.4	-18.6	
6146-11	02	1230	17	19	97.9	-2.1	
6146-3	04	1216	2	20	50.7	-49.3	
6153-4	04	1217	9	20	46.2	-53.8	
6146-2	04	1218	15	20	77.6	-22.4	
6146-1	04	1219	18	20	80.0	-20	
6145-19	05	1230	2	24	108.0	8	
6145-20	05	1231	11	24	76.8	-23.2	
6145-18	05	1232	19	24	207.0	107	
6145-17	05	1233	22	24	156.0	56	
6146-7	06	1222	2	19	54.3	-45.7	
6146-6	06	1223	9	19	65.3	-34.7	
6146-5	06	1224	14	19	87.0	-13	
6146-4	06	1225	17	19	98.8	-1.2	
6148-9	10	1215	2	20	32.4	-67.6	
6148-7	10	1215	9	20	63.2	-36.8	
6148-3	10	1217	15	20	119.0	19	

(Sheet 4 of 8)

Table E10 (Continued)							
ARDL Number	**Sample Station**	**Sample Time**	**Sample Depth ft**	**Water Depth ft**	**TSS (w/bk) mg/ℓ**	**TSS (w/o bk) mg/ℓ**	**Velocity fps**
6148-3	10	1217	15	20	119.0	19	
6148-2	10	1218	18	20	106.0	6	
6148-8	11	1234	2	20	63.9	-36.1	0.50
6148-6	11	1237	9	20	103.0	3.0	0.60
6148-1	11	1240	15	20	135.0	35.0	0.665
6147-20	11	1242	18	20	123.0	23.0	0.48
6148-10	12	1257	2	20	65.2	-34.8	
6148-11	12	1258	9	20	82.2	-17.8	
6148-5	12	1259	15	20	98.9	-1.1	
6148-4	12	1259	18	20	81.8	-18.2	
Sample Period 3							
6152-10	13	1545	3	22	182.0		1.70
6152-13	13	1546	11	22	417.0		1.90
6152-14	13	1547	17	22	364.0		1.70
6152-15	14	1557	3	20	473.0		2.20
6151-7	14	1558	10	20	312.0		1.70
6152-8	14	1559	15	20	431.0		1.30
6152-9	15	1607	3	10	399.0		2.15
6152-12	15	1608	5	10	688.0		2.30
6152-11	15	1609	7	10	419.0		1.98
6149-15	07	1530	2	20	330.0	-79.4	
6150-7	07	1531	9	20	364.0	-45.4	
6150-6	07	1533	15	20	47.3	-362.1	
6151-6	07	1532	18	20	507.0	97.6	
6150-8	08	1525	2	20	318.0	-91.4	
6150-20	08	1526	9	20	305.0	-104.4	
6150-4	08	1527	15	20	425.0	15.6	
6151-5	08	1528	18	20	690.0	280.6	
6150-12	09	1520	2	17	213.0	-196.4	
6150-5	09	1521	7	17	346.0	-63.4	

(Sheet 5 of 8)

Table E10 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6151-4	09	1521	13	17	360.0	-49.4	
6150-19	09	1522	15	17	292.0	-117.4	
6152-2	00	1615	8	26	350.0	-59.4	
6151-19	00	1615	15	26	287.0	-122.4	
6152-3	00	1615	20	26	469.0	59.6	
6151-14	00	1615	23	26	500.0	90.6	
6151-17	03	1615	8	25	300.0	-109.4	
6151-9	03	1615	15	25	376.0	-33.4	
6151-11	03	1615	20	25	478.0	68.6	
6151-15	03	1615	23	25	480.0	70.6	
6149-20	01	1500	2	19	250.0	-159.4	
6150-2	01	1500	9	19	383.0	-26.4	
6149-18	01	1500	14	19	463.0	53.6	
6150-1	01	1500	17	19	825.0	415.6	
6149-17	02	1520	2	19	231.0	-178.4	
6149-16	02	1520	9	19	264.0	-145.4	
6150-3	02	1520	14	19	401.0	-8.4	
6149-19	02	1520	17	19	708.0	298.6	
6150-16	04	1505	2	20	330.0	-79.4	
6151-1	04	1506	9	20	295.0	-114.4	
6150-11	04	1507	15	20	317.0	-92.4	
6150-14	04	1508	18	20	546.0	136.6	
6150-13	05	1515	2	24	265.0	-144.4	
6150-9	05	1516	10	24	425.0	15.6	
6150-18	05	1517	18	24	773.0	363.6	
6151-3	05	1518	22	24	903.0	493.6	
6150-10	06	1510	2	19	277.0	-132.4	
6150-15	06	1511	9	19	336.0	-73.4	
6151-2	06	1512	14	19	446.0	36.6	
6150-17	06	1513	17	19	365.0	-44.4	

(Sheet 6 of 8)

Table E10 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6149-14	10	1505	2	18	182.0	-227.4	
6149-9	10	1505	8	18	271.0	-138.4	
6149-11	10	1506	14	18	354.0	-55.4	
6149-12	10	1506	16	18	540.0	130.6	
6149-13	11	1511	2	20	219.0	-190.4	1.45
6149-4	11	1512	9	20	359.0	-50.4	0.825
6149-8	11	1513	15	20	520.0	110.6	0.975
6149-7	11	1514	18	20	630.0	220.6	0.85
6149-10	11	1514	18	20	569.0	159.6	0.85
6149-2	12	1525	2	20	201.0	-208.4	
6149-3	12	1525	9	20	275.0	-134.4	
6149-5	12	1526	15	20	259.0	-150.4	
6149-6	12	1526	18	20	479.0	69.6	
6138-20	16	1624	3	20	173.0	-236.4	0.10
6139-2	16	1625	10	20	223.0	-186.4	1.15
6153-5	16	1626	15	20	499.0	89.6	0.96
6139-5	17	1650	3	20	200.0	-209.4	1.45
6139-6	17	1652	10	20	252.0	-157.4	1.20
6138-19	17	1654	15	20	410.0	0.6	0.125
6139-3	18	1659	3	18	339.0	-70.4	0.90
6139-4	18	1701	9	18	292.0	-117.4	1.175
6139-1	18	1705	14	18	315.0	-94.4	1.20
6144-5	00	0900	6	24	143.0		
6143-14	00	0900	13	24	205.0		
6143-15	00	0900	18	24	1,190.0		
6143-17	00	0900	21	24	2,610.0		
6151-10	00	1345	8	27	105.0		
6151-20	00	1345	15	27	190.0		
6151-8	00	1345	20	27	338.0		

(Sheet 7 of 8)

Table E10 (Concluded)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6151-8	00	1345	20	27	338.0		
6152-1	00	1345	23	27	2,250.0		
6138-15	00	1645	8		519.0	109.6	
6138-14	00	1645	8		553.0	143.6	
6138-17	00	1645	15		149.0	-260.4	
6138-16	00	1645	20		604.0	194.6	
6138-18	00	1645	23		748.0	338.6	
6143-9	03	0900	6	24	35.2		
6143-13	03	0900	13	24	33.5		
6143-16	03	0900	18	24	102.0		
6143-7	03	0900	21	24	236.0		
6143-12	03	0900	21	24	191.0		
6152-6	03	1345	8	25	233.0		
6151-13	03	1345	15	25	257.0		
6151-18	03	1345	20	25	236.0		
6151-12	03	1345	23	25	736.0		
6152-5	03	1500	8	25	325.0	-84.4	
6151-16	03	1500	15	25	500.0	90.6	
6152-4	03	1500	20	25	442.0	32.6	
6152-7	03	1500	23	25	1,420.0	1,010.6	

(Sheet 8 of 8)

Table E11
Date: 5 August 1992 - Mobil Oil

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6156-4	13	1015	3	20	91.0		0.50
6153-15	13	1018	10	20	100.0		0.30
6156-1	13	1020	15	20	103.0		0.33
6156-2	14	1023	3	12	106.0		0.50
6153-20	14	1025	6	12	112.0		0.48
6156-3	14	1026	6	12	119.0		0.48
6153-16	14	1028	9	12	92.5		0.33
6153-19	15	1046	3	10	108.0		0.50
6153-17	15	1049	5	10	117.0		0.50
6153-14	15	1051	9	10	82.5		0.45
6153-11	16	0945	3	20	89.5	-13.5	0.45
6153-13	16	0947	10	20	87.5	-15.5	0.50
6153-18	16	0947	15	20	90.0	-13.0	0.44
6153-10	17	0955	3	20	96.5	-6.5	0.30
6153-6	17	0957	10	20	99.0	-4.0	0.40
6153-8	17	0959	15	20	95.0	-8.0	0.40
6153-7	18	1003	3	20	109.0	6.0	0.12
6153-9	18	1006	10	20	77.5	-25.5	0.30
6153-12	18	1009	15	20	74.0	-29.0	0.30

Table E12
Date: 6 August 1992 - Mobil Oil - Toyo Pump

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6191-7	13	0806	3	20	51.0		0.12
6191-9	13	0807	10	20	32.1		0.20
6198-7	13	0808	15	20	38.7		0.21
6191-2	14	0814	3	18	22.1		0.28
6191-10	14	0815	9	18	29.8		0.25
6191-4	14	0816	14	18	23.7		0.15
6191-6	15	0824	3	8	28.5		0.22
6191-5	15	0825	4	8	31.9		0.22
6191-3	15	0826	7	8	31.9		0.14
6191-8	15	0826	7	8	30.8		0.14
6193-6	07	0946	2	20	29.5	-2.6	
6192-10	07	0947	9	20	23.4	-8.7	
6192-16	07	0948	15	20	24.7	-7.4	
6193-1	07	0948	18	20	37.3	5.2	
6193-10	08	0954	2	20	22.8	-9.3	
6192-11	08	0955	9	20	24.4	-7.7	
6193-4	08	0957	15	20	24.4	-7.7	
6192-19	08	0958	18	20	31.2	-0.9	
6193-9	09	1000	2	20	31.4	-0.7	
6192-14	09	1001	9	20	27.2	-4.9	
6193-2	09	1002	15	20	28.6	-3.5	
6193-3	09	1003	18	20	444.0	411.9	
6193-13	03*	0945	2	19	<10.4		
6193-15	03*	0945	9	19	<10.7		
6193-16	03*	0945	14	19	<10.9		
6193-18	03*	0945	17	19	24.5	-7.6	
6194-4	01	0930	2	24	<15.0		
6198-11	01	0930	11	24	21.8	-10.3	
6194-1	01	0930	11	24	17.0	-15.1	
6194-2	01	0930	18	24	18.0	-14.1	

(Sheet 1 of 7)

Table E12 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6194-3	01	0930	22	24	22.0	-10.1	
6193-20	02	0955	2	19	<10.9		
6193-17	02	0955	2	19	<11.0		
6193-19	02	0955	9	19	<10.7		
6193-14	02	0955	14	19	21.4	-10.7	
6198-9	02	0955	17	19	12.9	-19.2	
6193-11	04	0938	2	24	27.5	-4.6	
6192-17	04	0939	10	24	49.2	17.1	
6192-13	04	0940	18	24	46.9	14.8	
6192-8	04	0940	18	24	48.6	16.5	
6193-7	04	0941	22	24	45.1	13	
6193-12	05	0931	2	20	27.1	-5	
6192-18	05	0932	9	20	46.1	14	
6192-9	05	0933	15	20	47.9	15.8	
6193-8	05	0934	18	20	41.4	9.3	
6192-15	06	0925	2	20	27.9	-4.2	
6192-20	06	0926	9	20	43.4	11.3	
6193-5	06	0927	15	20	84.1	52	
6192-12	06	0928	18	20	51.9	19.8	
6192-3	10	0925	2	20	21.7	-10.4	
6191-19	10	0926	9	20	40.0	7.9	
6192-2	10	0926	15	20	59.0	26.9	
6191-17	10	0927	18	20	73.2	41.1	
6192-7	11	0930	2	20	21.7	-10.4	-0.05
6192-1	11	0931	9	20	35.9	3.8	0.17
6192-5	11	0931	15	20	71.9	39.8	0.21
6192-6	11	0932	18	20	77.6	45.5	0.20
6191-16	12	0942	2	20	22.7	-9.4	
6191-18	12	0942	9	20	45.4	13.3	
6192-4	12	0943	15	20	36.9	4.8	

(Sheet 2 of 7)

Table E12 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6191-20	12	0943	18	20	55.0	22.9	
6190-13	16	0730	3	20	26.4	-5.7	0.02
6190-10	16	0731	10	20	34.2	2.1	0.20
6190-15	16	0732	15	20	43.4	11.3	0.28
6190-11	17	0739	3	20	24.0	-8.1	0.05
6190-14	17	0740	10	20	33.3	1.2	0.25
6190-16	17	0741	15	20	29.3	-2.8	0.28
6190-9	18	0750	3	20	20.0	-12.1	0.05
6198-12	18	0751	10	20	43.3	11.2	0.25
6190-12	18	0752	15	20	59.3	27.2	0.28
Sample Period 2							
6195-18	07	1257	2	23	20.7	-4	
6195-12	07	1258	10	23	23.7	-1	
6195-8	07	1258	17	23	31.2	6	
6195-5	07	1259	21	23	36.9	12	
6195-19	08	1301	2	20	21.4	-4	
6195-20	08	1302	10	20	19.7	-5	
6195-9	08	1303	15	20	31.3	6	
6195-7	08	1304	18	20	32.2	7	
6196-1	09	1305	2	16	21.0	-4	
6195-14	09	1306	7	16	19.7	-5	
6195-13	09	1307	12	16	22.0	-3	
6195-6	09	1308	14	16	26.8	2	
6197-9	03	1250	2		<10.7		
6197-7	03	1250	9		<10.9		
6197-17	03	1250	14		<10.6		
6197-18	03	1250	17		<10.6		
6197-15	01	1230	2	24	<11.0		
6197-8	01	1230	18	24	30.1	5	
6197-14	01	1230	22	24	<30.0		

(Sheet 3 of 7)

Table E12 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6197-16	02	1300	2		<11.0		
6197-19	02	1300	9		<10.4		
6197-12	02	1300	14		<10.9		
6197-6	02	1300	17		<10.7		
6195-2	04	1249	3		23.1	-2	
6195-1	04	1250	11		47.1	22	
6194-17	04	1251	19		46.0	21	
6195-17	04	1252	23		46.2	21	
6194-20	04	1252	23		47.5	23	
6195-3	05	1242	2	20	21.7	-3	
6194-19	05	1243	9	20	24.0	-1	
6194-18	05	1244	15	20	32.5	8	
6195-11	05	1245	18	20	44.7	20	
6195-4	06	1235	2		19.7	-5	
6195-10	06	1236	9		59.0	34	
6195-16	06	1236	10		186.0	161	
6195-15	06	1237	15		58.6	34	
6194-9	10	1230	2	20	19.0	-6	
6194-14	10	1230	9	20	31.0	6	
6194-15	10	1231	15	20	25.5	1	
6194-16	10	1231	18	20	28.0	3	
6194-8	11	1240	2	20	17.5	-8	-0.08
6194-7	11	1240	9	20	39.5	15	0.12
6194-11	11	1241	15	20	28.0	3	0.21
6194-13	11	1241	18	20	29.0	4	0.15
6194-10	12	1236	2	20	19.5	-6	
6194-12	12	1236	9	20	21.5	-4	
6194-5	12	1237	15	20	26.0	1	
6194-6	12	1237	18	20	26.5	2	

(Sheet 4 of 7)

Table E12 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 3							
6188-5	13	1617	3	20	15.5		0.05
6188-3	13	1618	10	20	21.7		0.12
6188-4	13	1619	15	20	19.7		0.04
6187-18	14	1626	3	18	12.9		0.05
6188-1	14	1627	9	18	16.4		0.15
6188-6	14	1628	14	18	17.2		0.05
6188-2	14	1629	14	18	20.3		0.05
6188-7	15	1634	3	8	20.3		0.10
6187-20	15	1635	4	8	20.7		0.10
6187-19	15	1636	7	8	22.7		0.15
6186-7	07	1556	2	23	14.6	-4.1	
6186-11	07	1557	10	23	25.3	6.6	
6185-9	07	1558	17	23	31.4	12.7	
6185-18	07	1559	21	23	26.2	7.5	
6186-9	08	1601	2	20	16.9	-1.8	
6185-16	08	1601	2	20	14.0	-4.7	
6185-17	08	1602	10	20	18.0	-0.7	
6198-6	08	1603	15	20	21.0	2.3	
6198-5	08	1604	15	20	26.4	7.7	
6185-10	08	1604	18	20	22.4	3.7	
6185-13	09	1606	2		16.2	-2.5	
6185-12	09	1607	7		18.5	-0.2	
6185-15	09	1608	11		22.9	4.2	
6185-14	09	1609	13		22.4	3.7	
6187-9	03*	1600	3		<10.4		
6186-17	03*	1600	11		<10.4		
6187-8	03*	1600	19		140.0	121.3	
6187-6	03*	1600	23		472.0	453.3	

(Sheet 5 of 7)

Table E12 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6187-9	03*	1600	3		<10.4		
6186-17	03*	1600	11		<10.4		
6187-8	03*	1600	19		140.0	121.3	
6187-6	03*	1600	23		472.0	453.3	
6187-7	01	1530	2	21	<10.6		
6198-10	01	1530	9	21	<10.7		
6187-3	01	1530	16	21	17.7	-1	
6187-11	01	1530	19	21	126.0	107.3	
6187-14	02	1615	2	25	<10.7		
6187-4	02	1615	9	25	<10.7		
6187-15	02	1615	14	25	<10.7		
6187-10	02	1615	17	25	<10.8		
6187-17	02	1615	17	25	18.9	0.2	
6186-3	04	1539	2	22	29.8	11.1	
6186-15	04	1539	10	22	21.4	2.7	
6186-1	04	1540	16	22	20.7	2	
6186-5	04	1541	20	22	31.2	12.5	
6186-13	05	1544	2	20	22.8	4.1	
6185-19	05	1545	9	20	32.5	13.8	
6186-12	05	1546	15	20	32.4	13.7	
6186-8	05	1547	18	20	81.4	62.7	
6186-4	06	1550	2	20	25.2	6.5	
6185-20	06	1551	9	20	17.6	-1.1	
6186-14	06	1552	15	20	39.3	20.6	
6186-6	06	1553	18	20	212.0	193.3	
6185-5	10	1537	9	20	26.3	7.6	
6185-3	10	1538	15	20	29.8	11.1	
6185-8	10	1538	18	20	49.5	30.8	
6185-6	11	1546	2	20	22.4	3.7	0.02
6185-7	11	1548	9	20	31.9	13.2	0.09
							(Sheet 6 of 7)

Table E12 (Concluded)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6185-1	11	1550	15	20	35.9	17.2	0.15
6185-4	11	1554	18	20	106.0	87.3	0.12
6185-11	12	1540	2	20	19.8	1.1	
6185-2	12	1541	9	20	19.0	0.3	
6186-10	12	1541	15	20	49.7	31	
6186-2	12	1542	18	20	123.0	104.3	
6183-8	16	1653	3	20	33.7	15.0	0.02
6183-1	16	1656	10	20	33.6	14.9	0.05
6183-2	16	1657	15	20	54.2	35.5	0.17
6183-4	17	1706	3	20	56.4	37.7	0.05
6183-9	17	1707	10	20	26.4	7.7	0.22
6198-13	17	1708	15	20	24.3	5.6	0.27
6183-7	18	1715	3	20	50.9	32.2	0.00
6183-5	18	1720	10	20	21.1	2.4	0.20
6183-6	18	1718	15	20	50.6	31.9	0.22

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Table E13
Date: 7 August 1992 - Mobil Oil - Toyo Pump

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6160-3	13	0811	3	22	17.0		0.12
6159-16	13	0812	11	22	29.0		0.12
6159-15	13	0813	16	22	41.3		0.02
6160-1	14	0819	3	18	20.2		0.20
6159-18	14	0820	9	18	37.8		0.16
6159-17	14	0821	14	18	71.4		0.10
6159-20	14	0821	14	18	70.1		0.10
6160-2	15	0828	3	10	<15.0		
6159-19	15	0828	5	10	26.5		0.15
6160-4	15	0829	7	10	24.0		0.13
6161-18	07	0927	2	20	18.2	-19.3	
6161-16	07	0928	9	20	35.7	-1.8	
6161-17	07	0929	15	20	15.3	-22.2	
6161-15	07	0930	18	20	16.1	-21.4	
6161-2	08	0933	2	20	21.0	-16.5	
6161-20	08	0934	9	20	23.5	-14	
6162-1	08	0935	15	20	29.9	-7.6	
6161-19	08	0935	18	20	62.6	25.1	
6162-3	09	0938	2	17	18.0	-19.5	
6162-4	09	0939	7	17	26.8	-10.7	
6162-5	09	0940	13	17	39.3	1.8	
6162-6	09	0941	15	17	37.0	-0.5	
6164-3	03*	0930	2	23	<10.6		
6164-11	03*	0930	10	23	30.0	-7.5	
6164-12	03*	0930	17	23	42.4	4.9	
6164-5	03*	0930	21	23	131.0	93.5	
6164-10	01	0915	2	19	<10.6		
6164-6	01	0915	9	19	19.9	-17.6	
6164-4	01	0915	14	19	47.9	10.4	

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Table E13 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6163-20	01	0915	17	19	15.0	-22.5	
6164-2	02	0940	2	19	<10.9		
6164-9	02	0940	9	19	25.3	-12.2	
6164-1	02	0940	14	19	229.0	191.5	
6164-8	02	0940	14	19	240.0	202.5	
6164-7	02	0940	17	19	192.0	154.5	
6161-5	04	0914	2	23	15.4	-22.1	
6161-7	04	0915	10	23	49.7	12.2	
6161-4	04	0916	17	23	64.9	27.4	
6161-3	04	0912	21	23	67.0	29.5	
6161-8	05	0920	2	20	19.2	-18.3	
6161-9	05	0918	9	20	44.0	6.5	
6161-10	05	0919	15	20	56.9	19.4	
6161-6	05	0920	18	20	66.1	28.6	
6161-14	06	0921	2	17	15.5	-22	
6161-13	06	0922	7	17	53.0	15.5	
6162-2	06	0923	13	17	69.5	32	
6161-12	06	0923	13	17	65.2	27.7	
6161-11	06	0924	15	17	64.0	26.5	
6160-13	10	0911	2	20	20.8	-16.7	
6160-16	10	0911	9	20	35.3	-2.2	
6161-1	10	0912	15	20	47.8	10.3	
6160-14	10	0912	18	20	54.0	16.5	
6160-11	11	0921	2	20	21.6	-15.9	0.30
6160-18	11	0921	9	20	34.2	-3.3	0.17
6160-17	11	0922	15	20	52.8	15.3	0.09
6160-10	11	0922	18	20	60.2	22.7	0.05
6160-12	12	0916	2	20	16.0	-21.5	
6160-15	12	0917	9	20	42.0	4.5	
6160-20	12	0917	15	20	61.1	23.6	

(Sheet 2 of 10)

Table E13 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6160-19	12	0918	18	20	55.6	18.1	
6159-6	16	0740	3	18	10.2	-27.3	0.12
6159-8	16	0740	8	18	11.8	-25.7	0.02
6159-3	16	0741	14	18	17.4	-20.1	0.02
6159-2	17	0748	3	20	10.9	-26.6	0.22
6159-7	17	0749	10	20	15.9	-21.6	0.12
6159-9	17	0750	15	20	21.6	-15.9	0.02
6159-4	18	0757	3	18	13.6	-23.9	0.18
6159-5	18	0758	10	18	18.9	-18.6	0.10
6159-1	18	0759	15	18	17.2	-20.3	0.03
Sample Period 2							
6163-15	07	1052	2	17	27.0	-3	
6163-6	07	1053	7	17	26.0	-4	
6163-10	07	1054	13	17	207.0	177	
6163-12	07	1055	15	17	210.0	180	
6163-7	08	1100	2	20	18.0	-12	
6163-13	08	1101	9	20	11.6	-18	
6163-19	08	1102	15	20	66.0	36	
6163-17	08	1103	18	20	80.0	50	
6166-15	09	1107	2	22	16.8	-13	
6166-17	09	1108	10	22	30.8	1	
6163-16	09	1108	10	22	29.0	-1	
6166-16	09	1109	16	22	30.8	1	
6163-18	09	1110	20	22	44.0	14	
6182-9	03*	1030	2	23	<9.4		
6165-2	03*	1030	10	23	<15.0		
6165-6	03*	1030	17	23	78.0	48	
6166-4	03*	1030	21	23	132.0	102	
6162-11	01	1015	2	20	<10.7		
6164-18	01	1015	9	20	68.7	39	

(Sheet 3 of 10)

Table E13 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6164-20	01	1015	15	20	216.0	186	
6164-19	01	1015	18	20	181.0	151	
6166-6	02	1045	2	19	18.6	-11	
6164-14	02	1045	9	19	100.0	70	
6165-5	02	1045	14	19	170.0	140	
6182-8	02	1045	17	19	90.7	61	
6163-3	04	1027	2	23	22.0	-8	
6163-2	04	1029	10	23	40.0	10	
6163-4	04	1028	17	23	70.4	40	
6163-8	04	1030	21	23	177.0	147	
6163-5	05	1035	2	19	20.0	-10	
6162-18	05	1036	9	19	29.0	-1	
6162-19	05	1037	14	19	83.8	54	
6162-20	05	1038	17	19	121.0	91	
6163-14	06	1042	2	18	14.0	-16	
6163-11	06	1043	8	18	110.0	80	
6163-1	06	1044	14	18	94.9	65	
6163-9	06	1045	16	18	100.0	70	
6165-12	10	1023	2	20	17.0	-13	
6165-7	10	1024	9	20	46.5	17	
6162-10	10	1025	15	20	44.8	15	
6182-3	10	1026	18	20	36.1	6	
6165-11	11	1037	2	20	20.5	-10	0.22
6182-5	11	1039	9	20	58.9	29	0.15
6182-4	11	1043	15	20	21.4	-9	0.03
6165-8	11	1045	18	20	61.0	31	0.02
6162-9	12	1030	2	20	24.7	-5	
6182-2	12	1030	12	20	<10.3		
6162-8	12	1030	15	20	59.7	30	
6165-9	12	1033	18	20	50.5	21	

(Sheet 4 of 10)

Table E13 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 3							
6168-15	07	1153	2	20	9.0	-16	
6168-14	07	1154	9	20	12.5	-13	
6168-12	07	1155	15	20	13.0	-12	
6165-17	07	1156	18	20	19.5	-6	
6168-18	07	1156	18	20	19.0	-6	
6168-9	08	1156	2	20	<7.5		
6168-11	08	1157	9	20	7.5	18	
6168-10	08	1158	15	20	15.5	-10	
6168-13	08	1200	18	20	18.0	-7	
6168-7	09	1201	2	17	11.5	-14	
6168-6	09	1202	7	17	<15.0		
6168-8	09	1203	13	17	22.5	-3	
6182-13	09	1204	15	17	77.5	53	
6167-9	03*	1140	2	23	<10.9		
6168-1	03*	1140	10	23	20.0	-5	
6166-3	03*	1140	17	23	111.0	86	
6168-4	03*	1140	21	23	44.3	19	
6167-18	01	1130	2	20	<10.7		
6166-2	01	1130	9	20	143.0	118	
6167-20	01	1130	15	20	143.0	118	
6167-10	01	1130	18	20	334.0	309	
6168-2	02	1150	2	19	<15.0		
6167-8	02	1150	9	19	32.2	7	
6167-17	02	1150	14	19	312.0	287	
6167-11	02	1150	17	19	158.0	133	
6169-8	04	1132	2	24	<10.6		
6169-2	04	1133	10	24	34.4	9	
6169-7	04	1134	18	24	10.9	-14	
6169-5	04	1135	22	24	37.6	13	
(Sheet 5 of 10)							

Table E13 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6169-6	05	1138	2	20	6.8	-18	
6168-20	05	1139	9	20	27.5	3	
6169-1	05	1139	15	20	70.9	46	
6169-3	05	1141	18	20	30.2	5	
6168-19	06	1145	2	20	<15.0		
6168-17	06	1146	9	20	28.5	4	
6168-16	06	1147	15	20	79.0	54	
6169-4	06	1148	18	20	54.3	29	
6166-19	10	1130	2	20	<7.5		
6165-15	10	1131	9	20	39.5	15	
6167-4	10	1131	15	20	36.9	12	
6166-20	10	1132	18	20	85.4	60	
6167-2	11	1140	2	20	21.2	-4	0.22
6166-18	11	1140	9	20	68.6	44	0.14
6167-1	11	1141	15	20	37.2	12	0.09
6165-16	11	1141	18	20	36.5	12	0.08
6165-13	12	1133	2	20	15.0	-10	
6165-14	12	1133	9	20	58.0	33	
6167-5	12	1134	15	20	59.4	34	
6167-3	12	1134	18	20	71.0	46	
Sample Period 4							
6174-19	07	1401	2	23	13.5	-7	
6174-18	07	1402	10	23	16.5	-4	
6174-17	07	1403	17	23	64.5	45	
6174-16	07	1404	21	23	110.0	90	
6174-15	08	1406	2	20	19.0	-1	
6174-14	08	1407	10	20	19.7	0	
6174-13	08	1409	15	20	22.5	3	
5174-12	08	1409	18	20	75.0	55	
6174-8	09	1410	2	17	<15.0		

(Sheet 6 of 10)

Table E13 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
5174-9	09	1411	7	17	9.2	-11	
5174-10	09	1412	13	17	20.0	0	
5174-11	09	1413	15	17	20.5	1	
6175-13	03*	1350	2	23	<15.0		
6175-16	03*	1350	10	23	92.0	72	
6175-18	03*	1350	17	23	115.0	95	
6176-13	03*	1350	21	23	240.0	220	
6175-12	01	1345	2	20	<15.0		
6175-15	01	1345	9	20	<15.0		
6182-15	01	1345	15	20	80.0	60	
6176-12	01	1345	18	20	118.0	98	
6176-14	02	1400	2	19	<21.4		
6176-10	02	1400	9	19	22.0	2	
6175-17	02	1400	14	19	85.0	65	
6175-14	02	1400	17	19	91.4	71	
6175-8	04	1346	2	23	23.2	3	
6175-9	04	1347	10	23	64.9	45	
6175-10	04	1348	17	23	56.0	36	
6175-11	04	1349	21	23	75.2	55	
6175-6	05	1352	2	20	31.6	12	
6175-5	05	1353	9	20	33.0	13	
6175-4	05	1354	15	20	99.0	79	
6175-7	05	1355	18	20	54.5	35	
6174-20	06	1357	2	17	10.0	-10	
6175-1	06	1358	7	17	18.0	-2	
6175-2	06	1359	13	17	39.0	19	
6175-3	06	1400	15	17	114.0	94	
6174-7	10	1343	2	20	13.9	-6	
6174-4	10	1343	9	20	48.4	28	
6174-6	10	1343	15	20	74.2	54	

(Sheet 7 of 10)

Table E13 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6174-3	10	1343	18	20	63.0	43	
6173-18	11	1352	2	20	22.4	2	0.12
6173-17	11	1352	9	20	55.3	35	0.09
6173-15	11	1353	15	20	82.5	63	0.09
6173-16	11	1353	18	20	61.4	41	0.10
5174-1	12	1348	2	20	12.2	-8	
5174-2	12	1348	9	20	46.6	27	
6174-5	12	1348	9	20	49.7	30	
6173-20	12	1349	15	20	76.2	56	
6173-19	12	1349	18	20	72.8	53	
Sample Period 5							
6180-12	13	1625	3	20	13.7		0.08
6180-15	13	1625	3	20	8.0		0.08
6180-14	13	1626	10	20	14.2		0.10
6180-11	13	1627	15	20	15.1		0.08
6180-16	14	1632	3	18	15.3		0.15
6180-17	14	1633	9	18	13.1		0.08
6180-10	14	1634	14	18	16.2		0.02
6180-18	15	1640	3	10	15.0		0.10
6180-19	15	1641	5	10	<5.2		
6180-13	15	1642	7	10	15.1		0.06
6180-4	07	1600	2	20	8.3	-5.7	
6179-20	07	1602	9	20	<7.5		
6179-12	07	1602	15	20	<7.5		
6179-7	07	1603	18	20	35.0	21	
6179-15	08	1608	2	20	<7.5	-14	
6180-6	08	1609	9	20	16.7	2.7	
6179-18	08	1610	15	20	34.5	20.5	
6179-13	08	1611	18	20	50.5	36.5	
6180-1	09	1616	2	20	<10.7		

(Sheet 8 of 10)

Table E13 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6180-7	09	1617	9	20	20.3	6.3	
6180-2	09	1618	15	20	30.3	16.3	
6182-18	09	1618	18	20	65.2	51.2	
6182-16	09	1649	18	20	55.8	41.8	
6178-18	03*	1550	2	19	<15.0		
6178-19	03*	1550	9	19	<15.0		
6178-20	03*	1550	14	19	28.0	14	
6179-1	03*	1550	17	19	58.0	44	
6179-2	01	1530	2	20	<15.0		
6179-3	01	1530	9	20	<15.0		
6179-4	01	1530	15	20	39.0	25	
6179-5	01	1530	18	20	84.0	70	
6178-17	02	1600	2	19	<21.4		
6178-16	02	1600	9	19	31.0	17	
6178-15	02	1600	14	19	57.0	43	
6178-14	02	1600	17	19	85.0	71	
6179-11	04	1536	2	23	<7.5		
6179-10	04	1537	10	23	<7.5		
6179-14	04	1538	17	23	<7.5		
6180-9	04	1539	21	23	67.9	53.9	
6179-16	05	1544	2	20	<15.0		
6180-3	05	1545	9	20	33.3	19.3	
6179-17	05	1546	15	20	44.0	30	
6180-8	05	1547	18	20	97.9	83.9	
6179-19	06	1552	2	20	<7.5		
6179-6	06	1552	2	20	14.0	0	
6180-5	06	1553	9	20	97.2	83.2	
6179-8	06	1554	15	20	65.0	51	
6179-9	06	1555	18	20	78.5	64.5	
6178-3	10	1533	2	20	<15.0		

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Table E13 (Concluded)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6178-4	10	1533	9	20	22.0	8	
6178-1	10	1534	15	20	52.0	38	
6178-2	10	1534	18	20	58.0	44	
6177-16	11	1542	2	20	<15.0		
6177-15	11	1543	9	20	37.1	23.1	0.08
6177-14	11	1544	15	20	29.0	15.0	0.05
6177-13	11	1545	18	20	63.0	49.0	0.05
6177-20	12	1536	2	20	10.0	-4	
6177-19	12	1537	9	20	34.0	20	
6177-17	12	1538	15	20	50.0	36	
6177-18	12	1540	18	20	74.0	60	
6181-11	16	1700	3	18	20.4	6.4	0.08
6181-9	16	1701	9	18	13.5	-0.5	0.13
6181-8	16	1702	14	18	18.5	4.5	0.10
6181-7	17	1722	3	20	11.0	-3.0	0.02
6181-10	17	1723	10	20	23.5	9.5	0.05
6181-5	17	1724	15	20	78.9	64.9	0.05
6181-4	18	1730	3	18	20.0	6.0	0.05
6181-3	18	1731	9	18	36.4	22.4	0.05
6181-6	18	1732	14	18	64.5	50.5	0.10

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Table E14
Date: 8 August 1992 - Dead Man's Creek - Toyo Pump

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 1							
6210-17	13	0831	3	26	11.5		0.30
6212-16	13	0832	13	26	17.3		0.28
6210-18	13	0834	20	26	27.5		0.25
6212-20	14	0840	3	28	15.9		0.18
6212-15	14	0841	14	28	11.4		0.15
6212-17	14	0842	21	28	23.9		0.20
6212-14	15	0848	3	26	17.1		0.20
6212-18	15	0847	13	26	20.9		0.11
6212-19	15	0852	20	26	18.9		0.15
6204-5	07	1016	2	23	16.4	-1.8	
6203-20	07	1017	10	23	15.7	-2.5	
6204-17	07	1018	17	23	17.9	-0.3	
6205-9	07	1020	21	23	22.0	3.8	
6204-6	08	1021	3	29	16.1	-2.1	
6204-7	08	1022	13	29	19.6	1.4	
6204-18	08	1023	22	29	17.9	-0.3	
6204-8	08	1024	26	29	19.6	1.4	
6204-3	09	1025	3		8.0	-10.2	
6203-18	09	1025	3		<10.7		
6204-9	09	1027	11		19.6	1.4	
6204-19	09	1029	19		28.4	10.2	
6205-10	09	1030	23		22.5	4.3	
6203-8	03*	1015	3	27	<10.7		
6202-16	03*	1015	12	27	<10.9		
6203-11	03*	1015	20	27	<11.0		
6203-9	03*	1015	24	27	11.9	-6.3	
6202-17	02	1000	3		<11.2		
6203-16	02	1000	12		<10.9		
6203-15	02	1000	20		<11.2		

(Sheet 1 of 7)

Table E14 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6203-12	02	1000	24		<10.7		
6203-17	02	1000	24		<11.0		
6204-12	04	0954	3	27	17.8	-0.4	
6204-1	04	0955	12	27	15.5	-2.7	
6204-11	04	0956	20	27	17.6	-0.6	
6204-16	04	0957	24	27	15.2	-3	
6203-14	01	0945	2	21	<10.6		
6203-10	01	0945	9	21	18.3	0.1	
6203-13	01	0945	16	21	<11.0		
6203-7	01	0945	19	21	10.8	-7.4	
6204-2	05	1003	3	27	11.6	-6.6	
6204-15	05	1004	12	27	<11.0		
6204-10	05	1005	20	27	19.6	1.4	
6205-8	05	1006	24	27	12.5	-5.7	
6204-14	06	1007	2	20	10.6	-7.6	
6204-4	06	1008	9	20	12.0	-6.2	
6203-19	06	1009	15	20	10.0	-8.2	
6204-13	06	1010	18	20	22.1	3.9	
6205-4	10	0951	3	26	<15.0		
6205-2	10	0951	12	26	<7.5		
6211-7	10	0952	20	26	11.4	-6.8	
6205-5	10	0952	23	26	18.5	0.3	
6211-6	11	1005	3	28	7.5	-10.7	0.30
6204-20	11	1005	13	28	9.7	-8.5	0.27
6205-1	11	1006	21	28	16.5	-1.7	0.30
6211-5	11	1006	25	28	8.4	-9.8	0.24
6211-4	12	1000	3	25	<10.7		
6205-6	12	1000	12	25	<7.5		
6205-3	12	1001	19	25	16.5	-1.7	
6205-7	12	1001	22	25	13.5	-4.7	

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Table E14 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6209-4	16	0742	3	25	<10.7		
6209-5	16	0743	3	25	16.2	-2.0	0.12
6209-6	16	0745	19	25	17.3	-0.9	0.01
6209-8	17	0753	3	28	8.0	-10.2	-0.10
6209-7	17	0755	14	28	15.5	-2.7	-0.10
6209-11	17	0756	21	28	15.5	-2.7	-0.04
6209-13	18	0805	3	28	<10.6		
6209-12	18	0806	14	28	10.7	-7.5	0.10
6209-10	18	0809	21	28	19.4	1.2	0.11
6209-9	18	0809	21	28	18.2	0.0	0.11
Sample Period 2							
6200-8	07	1312	3	24	<5.3		
6200-7	07	1313	11	24	9.9	-5.1	
6200-6	07	1314	19	24	7.0	-8	
6200-5	07	1315	22	24	10.9	-4.1	
6200-10	08	1318	4	29	9.5	-5.5	
6200-9	08	1320	13	29	<10.6		
6210-6	08	1321	22	29	8.0	-7	
6201-2	08	1322	26	29	<5.3		
6210-7	09	1324	4	27	11.0	-4	
6210-8	09	1325	12	27	11.0	-4	
6210-9	09	1326	21	27	<15.0		
6210-10	09	1327	25	27	<7.5		
6211-8	03*	1420	2	22	<10.3		
6213-11	03*	1420	10	22	15.0	0	
6211-11	03*	1420	17	22	<10.6		
6211-10	03*	1420	20	22	13.8	-1.2	
6213-8	02	1410	2	21	12.9	-2.1	
6211-9	02	1410	9	21	<10.3		
6213-9	02	1410	16	21	QNS		

(Sheet 3 of 7)

Table E14 (Continued)							
ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6213-10	02	1410	19	21	14.5	-0.5	
6200-17	04	1253	3		7.7	-7.3	
6200-16	04	1253	11		7.5	-7.5	
6200-15	04	1254	19		<10.7		
6200-14	04	1256	22		10.5	-4.5	
6213-7	01	1345	2	23	10.5	-4.5	
6213-5	01	1345	10	23	<10.7		
6213-4	01	1345	17	23	36.1	21.1	
6213-6	01	1345	21	23	20.8	5.8	
6201-1	05	1259	4		11.3	-3.7	
6200-20	05	1300	13		9.8	-5.2	
6200-19	05	1301	23		11.1	-3.9	
6200-18	05	1302	27		14.2	-0.8	
6200-11	06	1305	3	24	8.4	-6.6	
6200-1	06	1306	11	24	12.1	-2.9	
6200-3	06	1306	11	24	11.2	-3.8	
6200-2	06	1307	19	24	8.1	-6.9	
6200-4	06	1307	22	24	10.1	-4.9	
6201-6	10	1254	3	25	8.4	-6.6	
6201-12	10	1254	12	25	10.6	-4.4	
6200-13	10	1255	19	25	<5.2		
6201-9	10	1255	22	25	<10.7		
6201-11	11	1306	3	28	11.9	-3.1	-0.08
6200-12	11	1308	13	28	<5.2		
6201-5	11	1310	21	28	8.6	-6.4	-0.003
6201-8	11	1312	25	28	11.4	-3.6	0.04
6201-7	12	1300	3	26	10.5	-4.5	
6201-4	12	1300	12	26	9.1	-5.9	
6201-10	12	1301	20	26	9.4	-5.6	
6201-13	12	1301	23	26	11.5	-3.5	

(Sheet 4 of 7)

Table E14 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
Sample Period 3							
6205-17	13	1613	3	26	13.0		-0.05
6205-14	13	1614	14	26	18.0		0.15
6205-13	13	1616	20	26	16.0		0.15
6205-12	14	1622	3	28	15.0		0.05
6205-15	14	1623	14	28	17.5		0.20
6205-16	14	1624	21	28	15.5		0.11
6205-19	15	1611	3	26	12.0		0.05
6205-18	15	1632	13	26	10.5		0.12
6205-11	15	1634	20	26	<7.5		
6207-4	07	1548	2		16.5	1.8	
6206-18	07	1549	11		11.6	-3.1	
6206-13	07	1550	19		<5.3		
6206-17	07	1541	22		16.8	2.1	
6207-8	08	1552	3	27	8.4	-6.3	
6207-3	08	1553	12	27	9.1	-5.6	
6206-8	08	1553	20	27	12.6	-2.1	
6207-9	08	1554	24	27	12.9	-1.8	
6206-20	09	1558	3		17.6	2.9	
6207-1	09	1559	11		<10.5		
6207-2	09	1600	19		<5.3		
6207-7	09	1601	22		5.7	-9	
6208-14	03*	1550	2	22	<10.7		
6208-17	03*	1550	10	22	<10.6		
6208-20	03*	1550	17	22	<10.7		
6209-1	03*	1550	20	22	12.1	-2.6	
6208-13	02	1540	3	27	<10.6		
6208-16	02	1540	12	27	<11.0		
6208-19	02	1540	20	27	<10.9		
6209-2	02	1540	24	27	17.4	2.7	

(Sheet 5 of 7)

Table E14 (Continued)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6207-6	04	1532	3	27	<5.3		
6206-14	04	1533	12	27	15.2	0.5	
6206-10	04	1534	20	27	22.5	7.8	
6206-12	04	1535	23	27	<5.2		
6208-12	01	1530	2	24	<10.6		
6208-15	01	1530	15	24	<10.9		
6208-18	01	1530	18	24	<10.9		
6209-3	01	1530	22	24	25.0	10.3	
6206-16	05	1536	3	28	<5.3		
6206-11	05	1537	12	28	11.4	-3.3	
6206-15	05	1538	21	28	15.0	0.3	
6206-19	05	1539	25	28	44.9	30.2	
6206-9	06	1540	3		<10.9		
6207-11	06	1540	11		8.5	-6.2	
6207-5	06	1543	19		19.1	4.4	
6207-10	06	1542	23		13.1	-1.6	
6206-5	10	1531	3	25	<5.2		
6213-20	10	1531	3	25	11.2	-3.5	
6214-1	10	1532	12	25	15.7	1	
6214-2	10	1532	19	25	8.4	-6.3	
6206-6	10	1533	22	25	18.2	3.5	
6213-19	11	1552	3	28	17.5	2.8	0.50
6206-2	11	1552	13	28	14.6	-0.1	0.35
6206-3	11	1553	21	28	8.1	-6.6	0.30
6206-4	11	1553	25	28	27.2	12.5	0.21
6206-1	12	1542	3	25	<10.9		
6205-20	12	1542	12	25	15.5	0.8	
6213-18	12	1543	19	25	12.0	-2.7	
6206-7	12	1544	22	25	21.4	6.7	

(Sheet 6 of 7)

Table E14 (Concluded)

ARDL Number	Sample Station	Sample Time	Sample Depth ft	Water Depth ft	TSS (w/bk) mg/ℓ	TSS (w/o bk) mg/ℓ	Velocity fps
6215-5	16	1655	3	26	11.2	-3.5	0.10
6215-8	16	1657	13	26	19.6	4.9	0.09
6215-10	16	1658	20	26	16.4	1.7	-0.05
6215-7	16	1658	20	26	17.5	2.8	-0.05
6215-12	17	1712	3	28	18.2	3.5	0.22
6215-11	17	1713	14	28	18.0	3.3	0.10
6215-6	17	1714	21	28	18.6	3.9	0.13
6215-13	18	1725	3	28	16.4	1.7	
6215-9	18	1726	14	28	18.9	4.2	
6215-4	18	1727	21	28	17.8	3.1	

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Appendix F
Total Suspended Solids Above Background Summary Statistics

Table F1
Opened Clamshell Bucket with Sediment Dispersion Barrier - TSS Above Background

Sample Station	Depth	Up or Downstream Distance[1]	Sample Size	Mean	Minimum Value	Maximum Value	Variance	Standard Deviation	Standard Error
2-min Bucket Cycle Time (Days 3/1&2; 4/2&3)									
7-9	1-4	-440	51	6.08	-26.2	52.6	208.27	14.43	2.02
	1		5	-1.78	-5.7	4.0	14.89	3.86	1.73
	2		4	7.15	6.1	7.8	0.54	0.73	0.37
	3		4	8.48	-8.7	23.0	189.26	13.76	6.88
3	4	-90	4	18.43	7.9	36.0	179.91	13.41	6.71
0	1-4	0	13	24.95	-3.6	107.4	1,335.26	36.54	10.13
1	1-4	110	16	22.36	-4.9	60.4	524.05	22.89	5.72
	1		12	-4.98	-18.4	8.9	75.89	8.71	2.51
	2		11	4.22	-8.9	36.0	223.21	14.94	4.50
	3		11	14.04	-2.4	34.0	244.12	15.62	4.71
10-12	4	500	11	24.53	-2.2	78.0	758.46	27.54	8.30
16-18	1-3	2,160	21	7.62	-17.9	42.4	279.28	16.71	3.65
Geotextile Barrier									
2	1-4	-50	17	17.12	-8.4	80.4	698.62	26.43	6.41
4	1-4	-50	16	13.86	-2.6	38.0	130.06	11.4	2.85
5	1-4	240	17	15.9	-4.3	112.0	788.77	28.08	6.81
6	1-4	240	17	9.19	-18.9	70.0	353.96	18.81	4.56

(Sheet 1 of 3)

[1] Distance along channel baseline. For the given sample periods, distances are midway between extremes (see Table C12).

Table F1 (Continued)

Sample Station	Depth	Up or Downstream Distance[1]	Sample Size	Mean	Minimum Value	Maximum Value	Variance	Standard Deviation	Standard Error
4-min Bucket Cycle Time (Days 3/3 and 4/1)									
7-9	1-4	-490	23	3.92	-21.2	39.8	241.9	15.55	3.24
3	1-4	-90	8	-0.71	-31.3	44.0	576.86	24.02	8.49
0	1-4	0	10	-0.36	-32.2	35.4	674.17	25.96	8.21
1	1-4	90	9	7.34	-14.2	37.0	380.57	19.51	6.50
10-12	1-4	470	24	50.58	16.5	94.3	766.81	27.69	5.65
16-18	1	2,130	6	-37.58	-44.5	-29.2	41.66	6.45	2.63
	2		7	-7.64	-27.9	13.8	277.54	16.66	6.30
	3		7	-0.04	-16.7	20.2	321.70	17.94	6.78
Geotextile Barrier									
2	1-4	-100	8	21.74	-10.7	51.6	609.81	24.69	8.73
4	1-4	-100	8	-1.78	-16.9	18.6	165.29	12.86	4.55
5	1-4	230	8	8.26	-8.6	28.4	252.45	15.89	5.62
6	1-4	230	9	10.23	-14.3	58.6	849.44	29.15	9.71
Unknown Bucket Cycle Time (Day 2/1-3)									
7-9	1	-300	6	-19	-29.0	-7.0	78.4	8.85	3.61
	2		7	7.14	-8.0	20.0	109.48	10.46	3.95
	3		6	-11.83	-35.0	13.0	468.97	21.66	8.84
	4		6	7.33	-13.0	21.0	177.87	13.34	5.45

(Sheet 2 of 3)

Table F1 (Concluded)

Sample Station	Depth	Up or Downstream Distance[1]	Sample Size	Mean	Minimum Value	Maximum Value	Variance	Standard Deviation	Standard Error
Unknown Bucket Cycle Time (Day 2/1-3) (Continued)									
3	1-4	-90	4	20.5	-27.0	42.0	1,047.0	32.36	16.18
0	1-4	0	4	11.5	-13.0	37.0	497.67	22.31	11.16
1	1-4	NR	8	6.63	-34.0	43.0	757.41	27.52	9.73
10-12	1-4	640	25	-31.16	-68.0	8.0	554.97	23.56	4.71
16-18	1-3	2,300	8	-119.03	-132.7	-90.2	187.86	13.71	4.85
Geotextile Barrier									
2	1	100	2	-15	-20.0	-10.0	50.0	7.07	5.00
	2		2	14.5	9.0	20.0	60.5	7.77	5.49
	3		2	28.5	28.0	29.0	0.05	0.71	0.50
	4		2	66.0	29.0	103.0	2,738.0	52.32	37.0
4	1	100	2	-28.0	-30.0	-26.0	8.0	2.82	1.99
	2		2	13.0	1.0	25.0	288.0	16.97	12.00
	3		2	12.0	10.0	14.0	8.0	2.28	1.61
	4		2	20.5	17.0	24.0	24.5	4.94	3.49
5	1	300	2	-17.5	-20.0	-15.0	12.5	3.55	2.51

(Sheet 3 of 3)

Table F2
Opened Clamshell Bucket - TSS Above Background, 2-Min Bucket Cycle Time

Sample Station	Depth	Up or Downstream Distance[1]	Sample Size	Mean	Minimum Value	Maximum Value	Variance	Standard Deviation	Standard Error
2-min Bucket Cycle Time (Day 6/1&2)									
7	1-4	-120	8	48.0	15	91.0	782.86	27.98	9.89
8			8	40.13	-29.0	131.0	3,130.98	55.96	19.78
9			8	-28.54	-65.0	19.0	865.48	29.42	10.40
0	1-4	0	4	-19.25	-39.0	-1.0	261.58	16.17	8.09
4	1-4	0	8	-29.76	-72.7	3.5	917.06	30.28	10.71
3	1-4	90	4	10.98	-62.1	74.0	4,721.54	68.71	34.36
1-2	1-4	190	17	56.74	-35.0	382.0	13,364.0	115.60	28.04
5-6	1	NR	4	-45.45	-67.9	-33.2	264.84	16.27	8.14
	2		6	-24.0	-67.5	22.5	1,197.0	34.59	14.12
	3		4	-23.25	-39.0	-13.5	127.41	11.28	5.64
	4		4	1.25	-6.0	8.5	57.08	7.55	3.78
10-12	1-3	990	10	-100	-114.0	-70.2	257.71	16.05	5.08
16-18	1-3	990	10	-100	-114.0	-70.2	257.71	16.05	5.08
3-min Bucket Cycle Time (Day 5/1-4)									
7-9	1	-160	9	-16.8	-27.5	-4.2	59.77	7.73	2.58
	2		9	-11.2	-19.2	4.7	77.57	8.81	2.94
	3		10	-2.38	-30.0	20.8	254.96	15.97	5.05
	4		9	5.56	-8.4	32.0	179.02	13.38	4.46

(Continued)

[1] Distance along channel baseline. For the given sample periods, distances are midway between extremes (see Table C13).

Table F2 (Concluded)

Sample Station	Depth	Up or Downstream Distance[1]	Sample Size	Mean	Minimum Value	Maximum Value	Variance	Standard Deviation	Standard Error
3-min Bucket Cycle Time (Day 5/1-4) (Continued)									
0	1-4	0	9	529.89	-22.1	3,060	1,016,128	1,008.03	336.01
4	1-4	0	12	-0.14	-21.7	73.0	712.28	26.67	7.7
3	1-4	90	4	-13.22	-35.5	13.0	416.68	20.41	10.21
1-2	1	160	6	-25.13	-30.3	-18.7	26.91	5.18	2.11
	2		6	-16.0	-23.2	-4.2	54.76	7.40	3.02
	3		7	7.81	-15.8	67.0	778.69	27.9	10.55
	4		5	58.0	21.2	123.0	2,031.89	45.07	20.16
5-6	1	NR	5	-10.92	-28.5	4.3	169.29	13.01	5.82
	2		6	-4.36	-11.4	3.5	51.7	7.19	2.94
	3		7	12.44	-0.7	28.1	113.85	10.67	4.03
	4		6	10.06	-3.1	39.0	2.42	15.55	6.35
10-12	1	540	10	-14.12	-34.3	2.8	161.51	12.71	4.02
	2		9	-11.51	-25.4	3.2	128.49	11.34	3.78
	3		9	4.7	-38.3	72.3	1,144.72	33.83	11.28
	4		9	26.13	-9.2	62.3	585.39	24.19	8.06
16-18	1-3	960	17	3.16	-17.9	28.0	151.57	12.31	2.99

Table F3
Closed Clamshell Bucket - TSS Above Background, 1-Min Bucket Cycle Time

Sample Station	Depth	Up or Downstream Distance[1]	Sample Size	Mean	Minimum Value	Maximum Value	Variance	Standard Deviation	Standard Error
1-min Bucket Cycle Time (Day 9/1&2)									
7-9	1	-170	6	-9.08	-15.2	-3.9	24.33	4.93	2.01
	2		7	-4.83	-15.2	0.8	28.62	5.35	2.02
	3		6	5.23	-1.6	20.8	73.31	8.56	3.49
	4		5	10.66	-2.0	29.6	167.91	12.96	5.8
0	1-4	0	8	607.55	107.6	1,971.6	481,904.9	694.19	245.4
4	1-4	0	8	6.49	-11.4	71.6	798.95	28.27	9.99
3	1-4	90	9	213.67	8.7	663.0	43,109.26	207.63	69.21
1-2	1-4	170	13	88.87	-21.6	235.6	6,567.35	81.04	22.48
5-6	1	240	4	-0.975	-10.8	10.4	81.5	9.02	4.51
	2		5	9.16	-9.2	55.6	705.48	26.56	11.88
	3		4	38.8	15.1	57.7	371.58	19.27	9.64
	4		4	236.55	85.6	479.6	32,301.63	179.7	89.85
10-12	1	540	6	-2.2	-18.0	10.8	138.99	11.79	4.81
	2		6	8.57	-0.4	17.2	57.89	7.61	3.11
	3		6	31.97	1.4	62.4	510.41	22.59	9.22
	4		6	39.58	6.4	74.3	660.37	25.7	10.49
16-18	1	1,140	3	-4.37	-7.3	-2.4	6.7	2.59	1.5
	2		3	8.4	-0.4	20.4	115.84	10.76	6.26
	3		3	10.8	8	14.5	11.17	3.34	1.93

(Continued)

[1] Distance along channel baseline. For the given sample periods, distances are midway between extremes (see Table C14).

Table F3 (Concluded)

Sample Station	Depth	Up or Downstream Distance[1]	Sample Size	Mean	Minimum Value	Maximum Value	Variance	Standard Deviation	Standard Error
2-min Bucket Cycle Time (Days 9/3 and 10/1-3)									
7-9	1-4	-70	34	-18.61	-196.4	15.6	1,919.68	43.81	7.51
0	1-4	0	17	854.29	-122.4	11,566	7,788,159	2,790.73	676.85
4	1-4	0	16	-18.55	-114.4	136.6	3,242.32	56.94	14.24
3	1-4	90	15	74.23	-109.4	858	51,971.09	227.97	58.86
1-2	1-4	190	29	7.86	-178.4	415.6	12,456.0	111.61	20.73
5-6	1-4	390	33	44.97	-144.4	493.6	18,935.67	137.61	23.95
10-12	1	690	12	-64.5	-227.4	6.2	8,082.34	89.9	25.95
	2		12	-21.73	-138.4	46.4	3,556.76	59.64	17.22
	3		12	20.74	-150.4	110.6	4,909.58	70.07	20.23
	4		14	73.32	-18.2	220.6	4,289.98	65.5	17.51
16-18	1-3	1,290	28	-27.78	-236.4	89.6	6,876.95	82.93	15.67
3-min Bucket Cycle Time (Days 7/1 and 8/1-3)									
7-9	1-4	-140	49	32.07	-81.1	229.5	7,829.28	88.48	12.64
0	1-4	0	17	61.86	-61.9	661.1	29,353.63	171.33	41.55
4	1-4	0	15	25.15	-57.7	199.5	4,760.12	68.99	17.81
3	1-4	90	19	91.74	-64.5	365.5	18,060.89	134.39	30.83
1-2	1-4	190	32	39.20	-47.8	397.5	7,540.69	86.83	15.35
5-6	1-4	250	33	27.49	-48.8	252.5	5,205.18	72.15	12.56
10-12	1-4	510	45	20.81	-77.8	180.5	3,254.98	57.05	8.50
16-18	1-3	1,040	29	33.54	-45.8	145.1	1,710.23	41.35	7.68

Table F4
Submersible Pump - TSS Above Background, (Mobile Oil - Days 12/1-3 and 13/1-5)

Sample Station	Depth	Up or Downstream Distance[1]	Sample Size	Mean	Minimum Value	Maximum Value	Variance	Standard Deviation	Standard Error
7-9	1	-150	21	-7.69	-19.5	-0.2	40.37	6.35	1.39
	2		24	-4.50	-18.4	6.6	47.22	6.87	1.40
	3		23	3.73	-22.2	44.5	22.52	14.92	3.11
	4		22	17.8	-21.4	90.0	737.74	27.16	5.79
4	1-4	0	30	20.25	-22.1	147.0	904.65	30.07	5.49
3	1-4	90	16	84.58	-7.6	453.3	13,324.69	115.43	28.86
1-2	1-4	130	40	66.7	-22.5	309.0	7,260.7	85.2	13.47
5-6	1	360	14	-6.44	-22.0	11.6	100.11	10.0	2.67
	2		16	18.22	-2.0	83.2	702.08	26.49	6.62
	3		17	43.95	7.5	161.0	1,318.27	36.3	8.80
	4		16	54.12	5.2	193.3	2,216.19	47.08	11.77
10-12	1	660	20	-7.7	-21.5	3.7	39.31	6.27	1.40
	2		24	15.4	-3.5	43.6	175.34	13.24	2.70
	3		24	22.53	-8.6	62.5	349.92	18.7	3.82
	4		24	35.97	1.5	104.3	670.28	25.88	5.28
16-18	1-3	1,460	27	3.63	-29.0	37.7	323.63	17.99	3.46

[1] Distance along channel baseline. For the given sample periods, distances are midway between extremes (see Table C15).

Table F5
Submersible Pump - TSS Above Background (Upstream Dead Man's Creek - Day 14/1-3)

Sample Station	Depth	Up or Downstream Distance[1]	Sample Size	Mean	Minimum Value	Maximum Value	Variance	Standard Deviation	Standard Error
7-9	1-4	-710	28	-1.91	-10.2	10.2	20.82	4.56	0.86
2 & 4	1-4	0	12	-3.00	-7.5	0.0	7.62	2.75	0.79
1	1-4	NR	6	4.23	-7.4	21.1	110.49	10.51	4.29
5-6	1-4	200	22	-1.99	-8.2	30.2	64.15	8.0	1.71
10-12	1-4	800	28	-2.83	-10.7	12.5	25.34	0.95	0.18
16-18	1-4	3,000	18	0.044	-10.2	4.9	17.45	0.98	0.23

[1] Distance along channel baseline. For the given sample periods, distances are midway between extremes (see Table C16).

Appendix G
Water Column Chemistry

Table G1
Metal Levels, 27 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/Silt Screen)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6047-7	1700	01	3		0.0080	0.0120	0.0074	0.0800
6041-8	1700	01	3	F	<0.0080	<0.0100	0.0012	0.0640
6047-5	1700	01	12		<0.0080	<0.0100	0.0096	0.0930
6040-20	1700	01	12	F	<0.0080	0.0180	0.0016	0.0630
6047-6	1700	01	19		0.0100	0.0100	0.0080	0.0740
6041-5	1700	01	19	F	0.0081	0.0130	0.0086	0.0740
6047-8	1700	01	22		<0.0080	0.0140	0.0066	0.0700
6041-11	1700	01	22	F	<0.0080	<0.0100	0.0066	0.0930
6047-2	1647	110	3		<0.0080	<0.0100	0.0079	0.0180
6040-18	1645	11	3	F	<0.0080	0.0190	0.0012	0.0700
6047-4	1650	11	13		<0.0080	<0.0100	0.0099	0.0670
6040-4	1650	11	13	F	<0.0080	0.0240	0.0021	0.0930
6047-1	1652	11	22		<0.0080	<0.0100	0.0100	0.0180
6040-14	1653	11	22	F	0.0270	0.0200	<0.0010	0.0510
6047-3	1654	11	26		<0.0080	0.0120	0.0140	0.0340
6042-4	1655	11	26	F	<0.0080	0.0130	0.0010	0.0570
6068-6		13-15			<0.0080	0.0130	<0.0010	0.1000
6068-11		13-15		F	<0.0080	0.0530	0.0012	0.0640
6068-1		16-18			<0.0080	0.0160	0.0048	0.0600
6067-15		16-18		F	<0.0080	0.0220	0.0069	0.0480

Table G2
Metal Levels, 28 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/Silt Screen)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6049-12	AM	13-15			<0.0080	0.0190	0.0100	0.1200
6049-13	AM	13-15		F	<0.0080	<0.0100	0.0063	0.0450
6048-17	AM	16-18			<0.0080	0.0110	0.0035	0.0390
6048-16	AM	16-18		F	<0.0080	0.0100	<0.0010	0.0550
6045-8	1200	01	3		<0.0080	<0.0100	0.0070	0.0680
6045-9	1200	01	3		<0.0080	0.0150	0.0058	0.0560
6056-3	1200	01	3	F	<0.0080	0.0270	0.0019	0.0400
6045-12	1200	01	12		<0.0080	0.0140	0.0094	0.0680
6056-5	1200	01	12	F	<0.0080	0.0240	0.0037	0.2600
6045-11	1200	01	20		<0.0080	0.0120	0.0090	0.0690
6053-1	1200	01	20	F	<0.0080	0.0100	0.0016	0.2400
6045-10	1200	01	23		<0.0080	0.0140	0.0090	0.0770
6056-4	1200	01	23	F	<0.0080	0.0250	0.0790	0.0410
6042-18	1145	11	3		<0.0080	0.0160	0.0062	0.0210
6044-12	1146	11	3	F	<0.0080	0.0110	0.0019	0.0630
6042-16	1149	11	13		<0.0080	0.0140	0.0042	0.0240
6044-15	1147	11	13	F	<0.0080	<0.0100	0.0017	0.0680
6042-17	1153	11	22		<0.0080	0.0220	0.0088	0.0350
6044-14	1150	11	22	F	<0.0080	0.0110	0.0120	0.0290
6042-15	1154	11	26		<0.0080	0.0200	0.0300	0.0500
6044-13	1153	11	26	F	<0.0080	0.0120	0.0050	0.0350
6056-2	PM	13-15			<0.0080	0.0240	0.0080	0.0820
6056-18	PM	13-15		F	<0.0080	<0.0100	<0.0010	0.0530
6056-16	PM	16-18			<0.0080	<0.0100	<0.0010	0.0810
6056-17	PM	16-18		F	<0.0080	<0.0100	<0.0010	0.0610

Table G3
Metal Levels for 29 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/Silt Screen)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6061-7	0814	13-15			<0.0080	0.0260	0.0030	0.0740
6061-6	0814	13-15		F	<0.0080	0.0310	0.0022	0.0480
6059-10	0716	16-18			<0.0080	0.0200	0.0016	0.0700
6061-5	0716	16-18		F	<0.0080	0.0270	<0.0010	0.0670
6064-3	1100	01	3		<0.0080	0.0280	0.0059	0.0990
6070-3	1100	01	3	F	<0.0080	<0.0100	<0.0010	0.0320
6064-4	1100	01	11		0.0100	0.0150	0.0270	0.0730
6070-2	1100	01	11	F	<0.0080	0.0150	0.0023	0.0280
6064-2	1100	01	19		<0.0080	<0.0100	0.0034	0.0190
6070-1	1100	01	19	F	<0.0080	0.0130	<0.0010	0.0390
6064-1	1100	01	23		<0.0080	0.0220	0.0039	0.1000
6070-10	1100	01	23	F	<0.0080	<0.0100	<0.0010	0.0470
6074-11	1401	11	3		<0.0080	0.0350	0.0024	0.0830
6075-6	1402	11	3	F	<0.0080	<0.0100	0.0014	0.0450
6074-13	1406	11	14		<0.0080	0.0190	0.0028	0.0570
6075-7	1408	11	14	F	<0.0080	<0.0100	<0.0010	0.0680
6074-10	1410	11	23		<0.0080	0.0400	0.0081	0.0600
6075-8	1412	11	23	F	<0.0080	<0.0100	<0.0010	<0.0100
6074-12	1412	11	27		<0.0080	0.0370	0.0013	0.0340
6075-5	1415	11	27	F	<0.0080	<0.0100	<0.0010	0.0570
6074-8	1420	13-15		F	<0.0080	<0.0100	<0.0010	0.0400
6074-9	1508	16-18		F	<0.0080	<0.0100	<0.0010	0.0430

Table G4
Metal Levels for 30 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6077-16	0843	13-15			0.0170	0.0260	0.0012	0.1500
6077-17	0843	13-15		F	<0.0080	<0.0100	0.0010	0.0570
6077-15	0803	16-18			<0.0080	<0.0100	0.0030	0.5100
6077-14	0803	16-18		F	<0.0080	0.0100	<0.0010	0.0140
6087-17	1515	00	6		<0.0080	<0.0100	0.0120	0.1800
6087-16	1515	00	13		<0.0080	0.0900	0.0170	0.1000
6121-15	1515	00	13	F	<0.0080	0.0330	0.0110	0.1000
6087-14	1515	00	18		<0.0080	<0.0100	0.0510	0.2500
6087-15	1515	00	21		<0.0080	0.0930	0.1900	0.0770
6121-16	1515	00	21	F	<0.0080	0.0370	0.0013	0.0810
6085-15	1444	01	2		0.0100	<0.0100	0.0043	0.0690
6085-14	1445	01	2		0.0100	<0.0100	0.0058	0.0480
6106-11	1445	01	2	F	<0.0080	0.0120	<0.0010	0.1500
6085-11	1445	01	8		<0.0080	<0.0100	0.0021	0.1000
6106-13	1445	01	8	F	<0.0080	0.0110	<0.0010	0.1200
6085-12	1445	01	14		<0.0080	<0.0100	0.0094	0.0770
6106-12	1445	01	14	F	<0.0080	0.0130	<0.0010	0.1500
6106-17	1445	01	16	F	<0.0080	0.0200	<0.0010	0.0920
6085-7	1452	11	2		<0.0080	<0.0100	0.0018	0.0510
6106-3	1450	11	2	F	<0.0080	0.0120	<0.0010	0.1000
6085-8	1455	11	9		<0.0080	<0.0100	0.0041	0.0970
6106-19	1454	11	9	F	<0.0080	0.0130	<0.0010	0.0890
6085-10	1458	11	15		<0.0080	<0.0100	0.0047	0.0540
6106-16	1458	11	15	F	<0.0080	0.0110	<0.0010	0.1500
6085-9	1450	11	16		<0.0080	<0.0100	0.0043	0.1000
6085-13	1500	11	18		0.0140	<0.0100	0.0130	0.0940

Table G5
Metal Levels for 31 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6108-9	0825	13-15			<0.0080	0.0260	0.0065	0.0800
6119-18	0825	13-15		F	<0.0080	<0.0100	<0.0010	0.0540
6109-19	0825	13-15		F	0.0080	<0.0100	<0.0010	0.0660
6107-14	0732	16-18			<0.0080	0.0130	0.0014	0.0710
6107-15	0732	16-18		F	<0.0080	<0.0100	<0.0010	0.0160
6114-1	1210	01	2		0.0110	0.0270	0.0033	0.1200
6120-14	1210	01	2	F	<0.0080	<0.0100	<0.0010	0.0600
6120-12	1210	01	2	F	<0.0080	<0.0100	<0.0010	0.0750
6113-20	1210	01	8		0.0092	<0.0100	0.0110	0.0950
6119-19	1210	01	8	F	<0.0080	<0.0100	<0.0010	0.0620
6120-5	1210	01	8	F	<0.0080	0.0100	<0.0010	0.0740
6114-2	1210	01	14		<0.0080	0.0270	0.0140	0.1200
6120-7	1230	01	14	F	<0.0080	0.0170	<0.0010	0.0430
6119-20	1230	01	14	F	<0.0080	0.0150	0.0011	0.0380
6114-3	1210	01	16		<0.0080	0.0100	0.0230	0.0570
6120-3	1210	01	16	F	<0.0080	0.0110	<0.0010	0.0290
6111-13	1210	11	2		<0.0080	0.0120	0.0033	0.0630
6120-10	1209	11	2	F	<0.0080	<0.0100	<0.0010	0.0530
6120-1	1209	11	2	F	<0.0080	0.0180	<0.0010	0.0950
6111-14	1211	11	9		<0.0080	<0.0100	0.0075	0.0320
6120-6	1211	11	9	F	<0.0080	<0.0100	<0.0010	0.0440
6120-4	1211	11	9	F	<0.0080	<0.0100	<0.0010	0.0190
6111-15	1213	11	15		<0.0080	<0.0100	0.0066	0.0440
6120-11	1212	11	15	F	<0.0080	<0.0100	<0.0010	0.0980
6120-9	1212	11	15	F	<0.0080	0.0170	<0.0010	0.0750
6111-11	1216	11	18		<0.0080	0.0180	0.0082	0.0970
6120-2	1215	11	18	F	<0.0080	0.0110	<0.0010	0.0750
6120-13	1215	11	18	F	<0.0080	<0.0100	<0.0010	0.0490
6107-2	1500	11	18	F	<0.0080	0.0120	<0.0010	0.0710

Table G6
Metal Levels for 31 July 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6117-3	1530	00	6		0.0180	0.0240	0.0110	0.1200
6121-17	1530	00	6	F	<0.0080	<0.0100	<0.0010	0.0850
6117-6	1530	00	13		<0.0080	0.0290	0.0170	0.1100
6121-18	1530	00	13	F	<0.0080	<0.0100	0.0012	0.0490
6117-5	1530	00	18		0.0170	0.0230	0.0170	0.1300
6121-19	1530	00	18	F	<0.0080	0.0190	0.0029	0.0640
6117-4	1520	00	21		0.0180	0.0230	0.0140	0.1300
6120-8	1530	00	21	F	<0.0080	0.0130	<0.0010	0.0820
6119-14	1651	13-15			<0.0080	<0.0100	0.0080	0.1400
6119-13	1651	13-15		F	<0.0080	<0.0100	<0.0010	0.0340
6107-13	1653	13-15			<0.0080	0.0220	0.0015	0.0590
6107-12	1653	13-15		F	<0.0080	0.0110	<0.0010	<0.0100
6121-20	1515	16-18		F	<0.0080	0.0200	<0.0010	0.0720
6107-11	1720	16-18			<0.0080	0.0180	0.0018	0.0330
6107-10	1720	16-18		F	<0.0080	<0.0100	<0.0010	0.0540

Table G7
Metal Levels for 01 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6092-9	0822	13-15			<0.0080	<0.0100	0.0030	0.0830
6092-10	0822	13-15		F	<0.0080	<0.0100	<0.0010	<0.0100
6092-12	0747	16-18			<0.0080	<0.0100	0.0029	0.0630
6092-11	0747	16-18		F	<0.0080	<0.0100	<0.0010	<0.0100
6094-6	1200	00	8		<0.0080	0.0160	0.0016	0.0700
6099-18	1200	00	8	F	<0.0080	<0.0100	<0.0010	0.0110
6094-5	1200	00	15		0.0110	0.0100	0.0014	0.0850
6100-12	1200	00	15	F	<0.0080	<0.0100	<0.0010	<0.0100
6094-3	1200	00	20		0.0100	<0.0100	0.0019	0.1200
6100-8	1200	00	20	F	<0.0080	<0.0100	<0.0010	0.0250
6094-4	1200	00	23		0.0085	0.0100	0.0017	0.0790
6100-10	1200	00	23	F	<0.0080	<0.0100	<0.0010	<0.0100
6093-11	1200	01	2		<0.0080	<0.0100	0.0028	0.0940
6100-6	1200	01	2	F	<0.0080	<0.0100	<0.0010	<0.0100
6094-9	1200	01	8		0.0084	0.0150	0.0019	0.1100
6100-1	1200	01	8	F	<0.0080	<0.0100	<0.0010	0.0240
6094-7	1200	01	14		0.0087	0.0150	0.0017	0.1200
6100-4	1200	01	14	F	<0.0080	<0.0100	<0.0010	<0.0100
6094-8	1200	01	16		0.0089	0.0150	0.0017	0.0990
6100-2	1200	01	16	F	<0.0080	<0.0100	<0.0010	<0.0100
6096-17	1215	11	2		0.0220	0.0150	0.0012	0.0990
6103-9	1215	11	2	F	<0.0080	<0.0100	<0.0010	<0.0100
6096-16	1217	11	9		0.0440	0.0170	0.0130	0.0570
6103-7	1217	11	9	F	<0.0080	<0.0100	<0.0010	<0.0100
6096-18	1219	11	15		0.0110	0.0150	0.0019	0.0830
6103-13	1219	11	15	F	<0.0080	<0.0100	<0.0010	0.0140
6096-19	1221	11	18		<0.0080	0.0120	0.0015	0.0690
6103-11	1221	11	18	F	<0.0080	0.0100	<0.0010	0.0260
6135-17	1615	13-15			<0.0080	0.0130	0.0022	0.0830
6104-15	1615	13-15		F	<0.0080	<0.0100	<0.0010	<0.0100
6135-18	1652	16-18			<0.0080	<0.0100	0.0030	0.0810
6104-17	1652	16-18		F	<0.0080	<0.0100	<0.0010	<0.0100

Table G8
Metal Levels for 03 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6122-11	0833	13-15			<0.0080	0.0150	0.0013	0.1100
6122-15	0833	13-15		F	<0.0080	<0.0100	<0.0010	0.0570
6122-12	0803	16-18			<0.0080	<0.0100	0.0013	0.0830
6122-17	0803	16-18		F	<0.0080	<0.0100	<0.0010	0.0600
6130-17	1200	00	6		0.0250	0.0100	<0.0010	0.0770
6134-16	1200	00	6	F	<0.0080	<0.0100	<0.0010	0.0760
6130-18	1200	00	13		<0.0080	0.0120	0.0018	0.0800
6134-15	1200	00	13	F	<0.0080	<0.0100	<0.0010	0.0560
6130-20	1200	00	18		<0.0080	0.0130	0.0038	0.1100
6134-18	1200	00	18	F	<0.0080	<0.0100	<0.0010	0.0440
6130-19	1200	00	21		0.0080	0.0240	0.0080	0.1800
6134-17	1200	00	21	F	<0.0080	<0.0100	<0.0010	0.0350
6128-3	1200	01	2		<0.0080	<0.0100	0.0032	0.0230
6130-11	1200	01	2	F	<0.0080	<0.0100	<0.0010	0.0410
6128-1	1200	01	10		<0.0080	0.0110	0.0036	0.0810
6130-10	1200	01	10	F	<0.0080	<0.0100	<0.0010	0.0400
6128-4	1200	01	17		<0.0080	<0.0100	0.0069	0.0600
6130-12	1200	01	17	F	<0.0080	<0.0100	<0.0010	0.0150
6128-2	1200	01	21		0.0080	0.0180	0.0110	0.1000
6130-9	1200	01	21	F	<0.0080	<0.0100	<0.0010	0.0270
6129-7	1215	11	2		<0.0080	<0.0100	<0.0010	0.0710
6129-12	1214	11	2	F	<0.0080	<0.0100	<0.0010	0.0600
6129-8	1218	11	9		<0.0080	<0.0100	<0.0010	0.0550
6129-10	1217	11	9	F	<0.0080	<0.0100	<0.0010	0.0570
6129-6	1221	11	15		<0.0080	<0.0100	0.0019	0.0790
6129-11	1221	11	15	F	<0.0080	<0.0100	<0.0010	0.0580
6129-5	1224	11	18		0.4200	<0.0100	0.0020	0.0780
6129-9	1223	11	18	F	<0.0080	<0.0100	<0.0010	0.0410
6136-7	1652	13-15			0.0080	<0.0100	0.0022	0.0610
6136-10	1652	13-15		F	<0.0080	<0.0100	<0.0010	0.0400
6136-8	1552	16-18			<0.0080	<0.0100	0.0041	0.1200
6136-9	1559	16-18		F	<0.0080	<0.0100	<0.0010	0.0650

Table G9
Metal Levels for 04 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6140-15	0920	13-15			<0.0080	<0.0100	0.0015	0.0670
6140-17	0920	13-15		F	<0.0080	<0.0100	<0.0010	0.0360
6139-20	0849	16-18			<0.0080	<0.0100	0.4700	0.0490
6140-16	0849	16-18		F	<0.0080	<0.0100	<0.0010	0.0350
6144-17	1200	00	8		<0.0080	0.0170	0.0051	0.0830
6147-15	1200	00	8	F	<0.0080	<0.0100	<0.0010	0.0260
6144-14	1200	00	15		<0.0080	0.0120	0.0036	0.0820
6147-13	1200	00	15	F	<0.0080	<0.0100	<0.0010	<0.0100
6144-20	1200	00	20		<0.0080	0.0190	0.0034	0.1000
6147-17	1200	00	20	F	<0.0080	<0.0100	<0.0010	0.0330
6144-11	1200	00	23		<0.0080	0.0200	0.0110	0.0700
6147-11	1200	00	23	F	<0.0080	<0.0100	<0.0010	0.0250
6147-4	1200	01	2		<0.0080	0.0110	0.0046	0.0890
6154-9	1200	01	2	F	<0.0080	<0.0100	<0.0010	0.0300
6147-2	1200	01	9		<0.0080	0.0250	0.0120	0.1300
6154-10	1200	01	9	F	<0.0080	<0.0100	<0.0010	0.0400
6147-3	1200	01	14		<0.0080	0.0180	0.0049	0.0800
6154-11	1200	01	14	F	<0.0080	<0.0100	<0.0010	0.0350
6147-5	1200	01	17		0.0110	0.0170	0.0091	0.1100
6154-8	1200	01	17	F	<0.0080	<0.0100	<0.0010	0.0300
6148-13	1234	11	2		<0.0080	0.0140	0.0080	0.0900
6154-19	1233	11	2	F	<0.0080	<0.0100	<0.0010	0.0310
6148-12	1237	11	9		<0.0080	<0.0100	0.0065	0.0560
6154-20	1236	11	9	F	<0.0080	<0.0100	<0.0010	0.0330
6148-14	1240	11	15		<0.0080	0.2800	0.0070	0.2100
6154-18	1239	11	15	F	<0.0080	<0.0100	<0.0010	0.0250
6148-15	1243	11	18		0.0090	0.0190	0.0098	0.1000
6149-1	1242	11	18	F	<0.0080	<0.0100	<0.0010	0.0260
6152-19	1545	13-15			<0.0080	0.0130	0.0067	0.0590
6152-16	1545	13-15		F	<0.0080	<0.0100	0.0010	0.0170
6139-8	1624	16-18			<0.0080	0.0260	0.0054	0.0970
6139-10	1624	16-18		F	<0.0080	<0.0100	<0.0010	0.0280

Table G10
Metal Levels for 05 August 92 - Mobil Oil - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6156-5	1015	13-15			<0.0080	0.0130	0.0053	0.0340
6156-14	1015	13-15		F	<0.0080	<0.0100	<0.0010	<0.0100
6156-9	0945	16-18			<0.0080	0.0110	0.0041	0.0260
6156-11	0945	16-18		F	<0.0080	<0.0100	<0.0010	0.0130

Table G11
Metal Levels for 06 August 92 - Mobil Oil - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6191-12	0806	13-15			<0.0080	<0.0100	0.0023	0.0390
6191-11	0806	13-15		F	<0.0080	<0.0100	<0.0010	0.0270
6190-18	0730	16-18			<0.0080	0.0160	0.0035	0.0640
6191-1	0730	16-18		F	<0.0080	<0.0100	<0.0010	<0.0100
6196-6	1315	00	2		<0.0080	<0.0100	0.0036	0.0220
6199-10	1315	00	2	F	<0.0080	<0.0100	<0.0010	<0.0100
6196-9	1315	00	9		<0.0080	<0.0100	0.0042	0.0120
6199-8	1315	00	9	F	<0.0080	<0.0100	<0.0010	0.0130
6196-3	1315	00	16		<0.0080	<0.0100	0.0061	0.0100
6199-6	1315	00	16	F	<0.0080	<0.0100	<0.0010	<0.0100
6196-2	1315	00	19		<0.0080	<0.0100	0.0069	0.0240
6199-14	1315	00	19	F	<0.0080	<0.0100	<0.0010	<0.0100
6196-8	1230	01	2		<0.0080	<0.0100	0.0035	0.0110
6199-19	1230	01	2	F	<0.0080	<0.0100	<0.0010	<0.0100
6196-7	1230	01	11		<0.0080	0.0100	0.0015	0.0320
6199-16	1230	01	11	F	<0.0080	<0.0100	<0.0010	<0.0100
6196-4	1230	01	18		<0.0080	0.0140	0.0058	0.0410
6198-14	1230	01	18	F	<0.0080	<0.0100	<0.0010	<0.0100
6196-5	1230	01	22		<0.0080	<0.0100	0.0038	0.0280
6199-12	1230	01	22	F	<0.0080	<0.0100	<0.0010	<0.0100
6189-19	1530	01	2		<0.0080	0.0140	0.0023	0.0520
6184-19	1530	01	2	F	<0.0080	<0.0100	<0.0010	<0.0100
6189-18	1530	01	9		<0.0080	<0.0100	0.0015	0.0970
6184-18	1530	01	9	F	<0.0080	<0.0100	<0.0010	<0.0100
6189-17	1530	01	16		<0.0080	0.0110	0.0110	0.1300
6184-17	1530	01	16	F	<0.0080	<0.0100	<0.0010	<0.0100
6189-16	1530	01	19		<0.0080	0.0260	0.0160	0.0720
6188-12	1546	11	2		<0.0080	<0.0100	0.0035	0.0840
6188-10	1545	11	2	F	<0.0080	<0.0100	<0.0010	<0.0100

(Continued)

Table G11 (Concluded)								
ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6188-8	1548	11	9		<0.0080	0.0100	0.0029	0.0750
6184-16	1530	11	9	F	<0.0080	<0.0100	<0.0010	0.0190
6188-9	1547	11	9	F	<0.0080	<0.0100	<0.0010	<0.0100
6188-13	1550	11	15		<0.0080	0.0130	0.0036	0.1400
6188-14	1550	11	15	F	<0.0080	<0.0100	<0.0010	<0.0100
6188-15	1554	11	18		<0.0080	0.0800	0.0130	0.1400
6188-11	1553	11	18	F	<0.0080	<0.0100	<0.0010	<0.0100
6190-4	1617	13-15			<0.0080	<0.0100	0.0029	0.0210
6190-7	1617	13-15		F	0.0100	<0.0100	<0.0010	0.0210
6184-20	1653	16-18		F	<0.0080	<0.0100	<0.0010	<0.0100

Table G12
Metal Levels for 07 August 92 - Mobil Oil - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6160-5	0811	13-15			<0.0080	0.0110	0.0026	0.0230
6160-9	0811	13-15		F	<0.0080	<0.0100	<0.0010	<0.0100
6159-13	0740	16-18			<0.0080	0.0450	0.0024	0.0430
6159-10	0740	16-18		F	<0.0080	<0.0100	<0.0010	0.0100
6171-13	1100	00	2		<0.0080	0.0100	0.0020	0.0770
6171-18	1100	00	2	F	<0.0080	<0.0100	<0.0010	<0.0100
6172-2	1100	00	9		<0.0080	0.0130	0.0028	0.1100
6171-17	1100	00	9	F	<0.0080	<0.0100	<0.0010	<0.0100
6171-12	1100	00	16		<0.0080	0.0150	0.0058	0.0770
6171-16	1100	00	16	F	<0.0080	<0.0100	<0.0010	<0.0100
6171-9	1100	00	19		<0.0080	0.0110	0.0044	0.1100
6171-19	1100	00	19	F	<0.0080	<0.0100	<0.0010	0.0120
6171-14	1015	01	2		<0.0080	<0.0100	0.0130	0.0450
6172-1	1015	01	2	F	<0.0080	<0.0100	<0.0010	0.0370
6162-12	1015	01	9		<0.0080	0.0140	0.0089	0.0660
6171-7	1015	01	9	F	<0.0080	<0.0100	<0.0010	<0.0100
6162-13	1015	01	15		<0.0080	0.0390	0.0120	0.0870
6171-5	1015	01	15	F	<0.0080	<0.0100	<0.0010	0.0450
6171-15	1015	01	18		0.0160	0.0180	0.0110	0.0890
6171-6	1015	01	18	F	<0.0080	<0.0100	<0.0010	<0.0100
6162-17	1037	11	2		<0.0080	0.0140	0.0035	0.0470
6171-8	1036	11	2	F	<0.0080	<0.0100	<0.0010	<0.0100
6162-15	1038	11	9		<0.0080	<0.0100	0.0036	0.0490
6171-20	1038	11	9	F	<0.0080	<0.0100	<0.0010	<0.0100
6162-16	1043	11	15		<0.0080	0.0150	0.0110	0.0490
6171-11	1042	11	15	F	<0.0080	<0.0100	<0.0010	<0.0100
6162-14	1045	11	18		<0.0080	0.0120	0.0051	0.0900
6171-10	1044	11	18	F	<0.0080	<0.0100	<0.0010	<0.0100
6181-15	1625	13-15			<0.0080	<0.0100	0.0017	0.0690
6181-12	1700	16-18			<0.0080	<0.0100	0.0110	0.0250
6181-13	1700	16-18		F	<0.0080	<0.0100	<0.0010	<0.0100

Table G13
Metal Levels for 08 August 92 - Dead Man's Creek - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Metals, mg/ℓ			
					Chromium	Copper	Lead	Zinc
6210-19	0831	13-15			<0.0080	<0.0100	0.0060	0.0940
6210-20	0831	13-15		F	<0.0080	<0.0100	<0.0010	0.0580
6211-19	0742	16-18			<0.0080	<0.0100	0.0031	0.0600
6211-20	0742	16-18		F	<0.0080	<0.0100	<0.0010	0.0840
6211-16	1345	01	2		<0.0080	<0.0100	0.0028	0.0420
6213-12	1345	01	2	F	<0.0080	<0.0100	<0.0010	0.0550
6211-17	1345	01	10		<0.0080	<0.0100	0.0026	0.0480
6214-12	1345	01	10	F	<0.0080	<0.0100	<0.0010	0.0410
6214-3	1345	01	17		<0.0080	<0.0100	0.0040	0.0470
6213-14	1345	01	17	F	<0.0080	<0.0100	<0.0010	0.0570
6211-18	1345	01	21		<0.0080	<0.0100	0.0023	0.0480
6213-16	1345	01	21	F	<0.0080	<0.0100	<0.0010	0.0460
6209-18	1306	11	3		<0.0080	0.0110	0.0120	0.0420
6209-15	1305	11	3	F	<0.0080	<0.0100	<0.0010	0.0440
6209-19	1308	11	13		<0.0080	<0.0100	0.0041	0.0530
6209-16	1307	11	13	F	<0.0080	<0.0100	<0.0010	0.0520
6209-17	1310	11	21		<0.0080	0.0130	0.0027	0.0500
6210-16	1309	11	21	F	<0.0080	<0.0100	<0.0010	0.0500
6209-20	1312	11	25		<0.0080	<0.0100	0.0027	0.0650
6210-15	1311	11	25	F	<0.0080	<0.0100	0.0015	0.0470
6214-14	1613	13-15			<0.0080	0.0120	0.0022	0.0220
.6214-15	1613	13-15		F	<0.0080	<0.0100	<0.0010	0.0540
6214-19	1655	16-18			<0.0080	0.0120	0.0022	0.0550
6214-20	1655	16-18		F	<0.0080	<0.0100	<0.0010	0.0160

Table G14
Nitrogen Ammonia Levels for 24 July 92 - Dead Man's Creek

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Nitrogen Ammonia, mg/ℓ
6035-12	1300	14	C9		0.038
6035-18	1600	17	C9		0.084

Table G15
Nitrogen Ammonia Levels for 27 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/Silt Screen)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Nitrogen Ammonia, mg/ℓ
6068-7	AM	13-15			<0.100
6068-12	AM	13-15		F	<0.100
6068-3	AM	16-18			<0.100
6067-17	AM	16-18		F	<0.100
6047-16	1700	01	3		0.024
6047-19	1700	01	12		0.068
6047-15	1700	01	19		0.037
6048-1	1700	01	22		<0.100
6047-14	1646	11	3		0.050
6047-17	1649	11	13		0.027
6047-18	1651	11	22		0.014
6047-13	1654	11	26		0.084

Table G16
Ammonia Nitrogen Levels for 28 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/Silt Screen)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6049-9	AM	13-15			0.076
6048-15	AM	16-18			<0.100
6045-13	1200	01	3		0.059
6045-4	1200	01	12		0.080
6045-15	1200	01	20		<0.010
6045-14	1200	01	23		0.093
6042-14	1145	11	3		<0.010
6042-12	1148	11	15		0.074
6042-13	1152	11	22		0.085
6042-11	1155	11	26		0.097
6056-7	PM	13-15			<0.100
6057-1	PM	16-18			0.065

Table G17
Ammonia Nitrogen Levels for 29 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/Silt Screen)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6061-2	0814	13-15			<0.100
6059-9	0716	16-18			<0.100
6064-12	1100	01	3		<0.100
6064-10	1100	01	11		<0.100
6064-9	1100	01	19		<0.100
6064-11	1100	01	23		<0.100
6075-2	1401	11	3		<0.100
6075-3	1406	11	14		<0.100
6075-1	1410	11	23		<0.100
6075-4	1413	11	27		<0.100

Table G18
Ammonia Nitrogen Levels for 30 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6088-2	0843	13-15			<0.100
6088-1	0803	16-18			<0.100
6088-4	1445	01	2		<0.100
6088-9	1445	01	8		<0.100
6088-5	1445	01	14		<0.100
6088-6	1445	01	16		<0.100
6088-8	1452	11	2		<0.100

Table G19
Ammonia Nitrogen Levels for 31 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6108-10	0825	13-15			<0.100
6107-17	0752	16-18			<0.100
6114-4	1210	01	2		0.110
6114-8	1210	01	8		0.110
6114-9	1210	01	14		0.130
6114-7	1210	01	16		<0.100
6111-20	1209	11	2		<0.100
6114-5	1211	11	9		<0.100
6111-12	1212	11	15		<0.100
6114-6	1215	11	18		0.100

Table G20
Ammonia Nitrogen Levels for 31 July 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6117-9	1530	00	6		<0.100
6117-7	1530	00	13		<0.100
6117-10	1530	00	18		<0.100
6117-8	1530	00	21		0.110
6119-15	1651	13-15			<0.100
6107-18	1653	13-15			0.150
6122-2	1551	16-18			0.120
6107-16	1720	16-18			0.120

Table G21
Ammonia Nitrogen Levels for 01 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6092-13	0822	13-15			<0.100
6092-14	0747	16-18			<0.100
6093-13	1200	01	2		<0.100
6093-12	1200	01	8		<0.100
6093-14	1200	01	14		<0.100
6093-15	1200	01	16		<0.100
6097-8	1215	11	2		<0.100
6097-5	1217	11	9		<0.100
6097-7	1220	11	15		<0.100
6097-6	1222	11	18		<0.100
6135-20	1651	13-15			<0.100
6135-19	1552	16-18			0.100

Table G22
Ammonia Nitrogen Levels for 03 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6122-9	0833	13-15			<0.100
6122-10	0803	16-18			<0.100
6131-4	1200	00	6		<0.100
6131-2	1200	00	13		<0.100
6131-1	1200	00	18		0.170
6131-3	1200	00	21		0.200
6128-6	1200	01	2		<0.100
6128-5	1200	01	10		<0.100
6128-7	1200	01	17		0.180
6128-8	1200	01	21		0.220
6130-3	1214	11	2		<0.100
6130-2	1218	11	9		<0.100
6130-1	1222	11	15		0.260
6130-4	1224	11	18		0.130
6136-11	1652	13-15			<0.100
6136-12	1559	16-18			0.110

Table G23
Ammonia Nitrogen Levels for 04 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6140-14	0920	13-15			<0.100
6140-1	0849	16-18			<0.100
6144-18	1200	00	8		<0.100
6144-15	1200	00	15		<0.100
6145-1	1200	00	20		<0.100
6144-12	1200	00	23		<0.100
6147-1	1200	01	2		<0.100
6146-18	1200	01	9		<0.100
6146-19	1200	01	14		<0.100
6146-20	1200	01	17		<0.100
6148-18	1233	11	2		<0.100
6148-17	1237	11	9		<0.100
6148-19	1240	11	15		<0.100
6148-16	1243	11	18		<0.100
6152-20	1545	13-15			<0.100
6139-9	1624	16-18			<0.100

Table G24
Ammonia Nitrogen Levels for 05 August 92 - Mobil Oil - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6156-7	1015	13-15			<0.100
6156-10	0945	16-18			<0.100

Table G25
Ammonia Nitrogen Levels for 06 August 92 - Mobil Oil - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6191-15	0806	13-15			<0.100
6190-17	0730	16-18			<0.100
6196-11	1315	00	2		<0.100
6196-12	1315	00	9		<0.100
6196-15	1315	00	16		<0.100
6196-10	1315	00	19		<0.100
6196-16	1230	01	2		<0.100
6196-13	1230	01	11		<0.100
6196-14	1230	01	18		<0.100
6196-17	1230	01	22		<0.100
6189-15	1530	01	2		<0.100
6189-14	1530	01	9		<0.100
6189-13	1530	01	16		0.130
6189-12	1530	01	19		0.150
6189-5	1546	11	2		<0.100
6189-7	1548	11	9		<0.100
6189-4	1550	11	15		<0.100
6189-6	1554	11	18		<0.100
6198-18	1617	13-15			<0.100

Table G26
Ammonia Nitrogen Levels for 07 August 92 - Mobil Oil - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6160-6	0811	13-15			<0.100
6159-14	0740	16-18			<0.100
6169-20	1100	00	2		<0.100
6169-17	1100	00	9		<0.100
6169-19	1100	00	16		0.120
6169-14	1100	00	19		<0.100
6169-18	1015	01	2		<0.100
6169-15	1015	01	9		<0.100
6169-11	1015	01	15		<0.100
6169-9	1015	01	18		<0.100
6169-13	1037	11	2		<0.100
6169-12	1039	11	9		<0.100
6169-16	1043	11	15		<0.100
6169-10	1045	11	18		0.130
6182-1	1625	13-15			<0.100
6181-20	1700	16-18			0.210

Table G27
Ammonia Nitrogen Levels for 08 August 92 - Dead Man's Creek - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Sample Type	Ammonia Nitrogen, mg/ℓ
6211-3	0831	13-15			<0.100
6209-14	0742	16-18			<0.100
6214-11	1345	01	2		<0.100
6214-9	1345	01	10		<0.100
6214-8	1345	01	21		<0.100
6214-10	1350	01	17		<0.100
6210-13	1306	11	3		<0.100
6210-14	1308	11	13		<0.100
6210-12	1310	11	21		<0.100
6210-11	1312	11	25		<0.100
6214-18	1613	13-15			<0.100
6215-3	1655	16-18			<0.100

Table G28
TOC Levels for 27 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/Silt Screen)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6068-8		13-15			7.900
6068-13		13-15		F	9.800
6068-2		16-18			9.600
6067-16	AM	16-18		F	7.000
6047-12	1700	01	3		9.200
6041-7	1700	01	3	F	7.300
6047-11	1700	01	12		10.100
6041-1	1700	01	12	F	16.400
6047-9	1700	01	19		10.600
6041-3	1700	01	19	F	8.500
6047-10	1700	01	22		9.900
6041-10	1700	01	22	F	8.200
6039-20	1645	11	3		8.400
6040-19	1645	11	3	F	7.600
6039-18	1650	11	13		11.000
6040-2	1650	11	13	F	8.900
6040-1	1653	11	22		18.100
6040-16	1653	11	22	F	14.100
6039-19	1655	11	26		11.200
6042-5	1655	11	26	F	8.800

Table G29
TOC Levels for 28 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/Silt Screen)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6049-11	AM	13-15			11.000
6049-10	AM	13-15		F	8.300
6048-13	AM	16-18			9.100
6048-12	AM	16-18		F	7.800
6045-18	1200	01	3		10.000
6056-13	1200	01	3	F	7.900
6045-17	1200	01	12		10.900
6056-11	1200	01	12	F	7.900
6045-7	1200	01	20		9.500
6045-6	1200	01	20		9.600
6053-3	1200	01	20	F	7.100
6045-16	1200	01	23		10.700
6056-12	1200	01	23	F	7.600
6042-7	1145	11	3		7.700
6044-11	1146	11	3	F	8.600
6042-9	1148	11	13		9.700
6044-10	1147	11	13	F	9.200
6042-8	1151	11	22		8.700
6044-8	1150	11	22	F	14.300
6042-10	1154	11	26		10.000
6044-9	1153	11	26	F	10.200
6056-10	PM	13-15			8.900
6056-19	PM	13-15		F	7.500
6056-14	PM	16-18			9.600
6056-15	PM	16-18		F	6.000

Table G30
TOC Levels for 29 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket w/Silt Screen)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6061-1	0814	13-15			8.600
6060-19	0814	13-15		F	9.700
6059-11	0716	16-18			8.000
6060-18	0716	16-18		F	10.100
6064-6	1100	01	3		8.200
6070-7	1100	01	3	F	29.500
6064-7	1100	01	11		9.700
6070-6	1100	01	11	F	16.300
6064-5	1100	01	19		9.400
6070-5	1100	01	19	F	12.800
6064-8	1100	01	23		9.000
6070-4	1100	01	23	F	10.000
6074-15	1401	11	3		10.300
6075-11	1402	11	3	F	7.900
6074-18	1407	11	14		9.900
6075-10	1408	11	14	F	8.100
6074-14	1413	11	23		10.500
6075-12	1412	11	23	F	9.200
6074-19	1413	11	27		9.300
6075-9	1415	11	27	F	8.400
6074-17	1420	13-15		F	22.600
6074-16	1508	16-18		F	7.500

Table G31
TOC Levels for 30 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6078-1	0843	13-15			11.500
6077-19	0803	16-18			12.300
6077-18	0803	16-18		F	12.400
6087-11	1515	00	6		18.400
6087-13	1515	00	13		11.700
6121-5	1515	00	13	F	13.900
6087-12	1515	00	18		22.500
6087-10	1515	00	21		45.700
6121-6	1515	00	21	F	11.300
6086-3	1445	01	2		12.400
6106-10	1445	01	2	F	10.100
6085-18	1445	01	8		11.700
6086-4	1445	01	8		14.100
6106-14	1445	01	8	F	10.300
6086-5	1445	01	14		14.000
6106-9	1445	01	14	F	9.600
6085-19	1445	01	16		12.800
6106-18	1445	01	16	F	9.600
6085-17	1453	11	2		12.000
6106-4	1450	11	2	F	12.900
6086-2	1456	11	9		12.200
6107-1	1454	11	9	F	10.700
6085-16	1458	11	15		13.400
6106-15	1458	11	15	F	10.800
6086-1	1500	11	18		13.700
6107-3	1500	11	18	F	12.000

Table G32
TOC Levels for 31 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6108-11	0825	13-15			8.200
6109-18	0825	13-15		F	7.600
6107-8	0732	16-18			29.800
6107-9	0732	16-18		F	9.400
6114-11	1210	01	2		13.100
6120-20	1210	01	2	F	16.900
6114-13	1210	01	8		13.900
6120-16	1210	01	8	F	10.000
6114-10	1230	01	14		18.400
6120-17	1230	01	14	F	10.800
6114-12	1210	01	16		15.800
6121-1	1210	01	16	F	10.900
6111-19	1209	11	2		10.600
6120-18	1209	11	2	F	15.000
6111-17	1211	11	9		12.000
6120-15	1211	11	9	F	10.200
6111-16	1213	11	15		15.900
6120-19	1212	11	15	F	13.300
6111-18	1215	11	18		12.300
6121-2	1215	11	18	F	10.100

Table G33
TOC Levels for 31 July 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6117-12	1530	00	6		15.000
6121-7	1530	00	6	F	11.900
6117-14	1530	00	13		17.200
6121-8	1530	00	13	F	10.700
6117-13	1530	00	18		33.500
6121-4	1530	00	18	F	10.400
6117-11	1530	00	21		17.000
6121-3	1530	00	21	F	8.000
6119-17	1651	13-15			17.200
6119-16	1651	13-15		F	8.100
6107-7	1653	13-15			13.500
6107-6	1653	13-15		F	13.400
6121-14	1551	16-18			15.800
6121-13	1551	16-18		F	7.500
6107-5	1720	16-18			12.800
6107-4	1720	16-18		F	9.800

Table G34
TOC Levels for 01 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6092-15	0822	13-15			13.200
6092-16	0822	13-15		F	9.700
6092-17	0747	16-18			11.100
6092-18	0747	16-18		F	11.900
6096-5	1200	00	8		12.400
6099-17	1200	00	8	F	10.400
6096-6	1200	00	15		12.200
6100-13	1200	00	15	F	11.200
6093-17	1200	00	20		13.700
6100-9	1200	00	20	F	15.400
6093-16	1200	00	23		13.500
6100-11	1200	00	23	F	11.300
6096-8	1200	01	2		15.200
6100-7	1200	01	2	F	11.400
6096-7	1200	01	8		11.100
6099-19	1200	01	8	F	18.000
6096-9	1200	01	14		12.600
6100-5	1200	01	14	F	11.300
6096-10	1200	01	16		11.100
6100-3	1200	01	16	F	9.800
6097-2	1215	11	2		11.700
6103-10	1215	11	2	F	9.400
6097-3	1218	11	9		11.300
6103-8	1217	11	9	F	9.200
6097-1	1220	11	15		9.600
6103-14	1219	11	15	F	10.900
6097-4	1222	11	18		10.700
6103-12	1221	11	18	F	QNS
6135-16	1651	13-15			7.400
6104-16	1615	13-15		F	9.300
6135-15	1552	16-18			7.900
6104-18	1652	16-18		F	12.800

Table G35
TOC Levels for 03 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6122-13	0833	13-15			7.900
6122-16	0833	13-15		F	35.900
6122-14	0803	16-18			8.300
6122-18	0803	16-18		F	8.200
6131-8	1200	00	6		7.400
6134-20	1200	00	6	F	7.500
6131-7	1200	00	13		7.900
6134-19	1200	00	13	F	7.400
6131-5	1200	00	18		0.790
6135-2	1200	00	18	F	7.900
6131-6	1200	00	21		12.800
6135-1	1200	00	21	F	26.300
6128-10	1200	01	2		7.100
6130-15	1200	01	2	F	7.700
6128-11	1200	01	10		9.100
6130-16	1200	01	10	F	7.800
6128-12	1200	01	17		10.600
6130-14	1200	01	17	F	9.300
6128-9	1200	01	21		14.100
6130-13	1200	01	21	F	10.400
6129-14	1215	11	2		7.300
6129-19	1214	11	2	F	7.400
6129-15	1218	11	9		7.700
6129-17	1217	11	9	F	7.300
6129-16	1222	11	15		8.800
6129-20	1221	11	15	F	8.300
6129-13	1224	11	18		9.300
6129-18	1223	11	18	F	7.700
6136-13	1652	13-15			7.400
6136-14	1559	16-18			7.000
6136-15	1559	16-18			8.100
6136-16	1559	16-18		F	8.600

Table G36
TOC Levels for 04 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6140-13	0920	13-15			7.300
6140-19	0920	13-15		F	8.000
6140-2	0849	16-18			8.000
6140-18	0849	16-18		F	6.100
6144-16	1200	00	8		7.900
6147-14	1200	00	8	F	7.700
6144-13	1200	00	15		8.200
6147-12	1200	00	15	F	6.800
6144-19	1200	00	20		7.800
6147-16	1200	00	20	F	8.300
6144-10	1200	00	23		9.300
6147-10	1200	00	23	F	7.100
6147-6	1200	01	2		7.400
6154-7	1200	01	2	F	8.500
6147-7	1200	01	9		8.900
6154-6	1200	01	9	F	10.800
6147-9	1200	01	14		7.900
6154-5	1200	01	14	F	15.200
6147-8	1200	01	17		7.100
6154-4	1200	01	17	F	8.900
6154-2	1233	11	2		8.100
6154-16	1233	11	2	F	7.500
6154-1	1236	11	9		8.100
6154-15	1236	11	9	F	11.000
6148-20	1240	11	15		7.200
6154-14	1239	11	15	F	13.600
6154-3	1243	11	18		11.800
6154-17	1242	11	18	F	7.700
6152-18	1545	13-15			15.900
6152-17	1545	13-15		F	8.100
6139-7	1624	16-18			17.900
6139-11	1624	16-18		F	9.100

Table G37
TOC Levels for 05 August 92 - Mobil Oil - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6156-6	1015	13-15			12.200
6156-13	1015	13-15		F	10.500
6156-8	0945	16-18			11.200
6156-12	0945	16-18		F	15.200

Table G38
TOC Levels for 06 August 92 - Mobil Oil - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6191-13	0806	13-15			5.900
6191-14	0806	13-15		F	6.300
6190-19	0730	16-18			7.300
6190-20	0730	16-18		F	6.600
6197-1	1315	00	2		8.300
6199-9	1315	00	2	F	7.000
6197-2	1315	00	9		6.500
6199-7	1315	00	9	F	5.800
6196-18	1315	00	16		5.100
6199-5	1315	00	16	F	6.200
6197-4	1315	00	19		5.800
6199-13	1315	00	19	F	6.900
6196-19	1230	01	2		6.500
6199-18	1230	01	2	F	7.300
6196-20	1230	01	11		5.500
6199-15	1230	01	11	F	6.400
6197-3	1230	01	18		6.000
6199-17	1230	01	18	F	10.800
6197-5	1230	01	22		6.300
6199-11	1230	01	22	F	6.500
6190-3	1530	01	2		5.900
6184-15	1530	01	2	F	6.900
6190-2	1530	01	9		6.300
6184-13	1530	01	9	F	6.800
6190-1	1530	01	16		6.400
6184-14	1530	01	16	F	6.300
6189-20	1530	01	19		7.200
6184-12	1530	01	19	F	13.300
6188-17	1546	11	2		6.500
6189-2	1545	11	2	F	8.100
6188-19	1548	11	9		7.100
6188-18	1547	11	9	F	6.900
6188-20	1550	11	15		6.200
6188-16	1550	11	15	F	6.800
6189-1	1554	11	18		7.400
6189-3	1553	11	18	F	7.600
6190-5	1617	13-15			6.000
6190-6	1617	13-15		F	14.700
6184-11	1653	16-18		F	7.300

Table G39
TOC Levels for 07 August 92 - Mobil Oil - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6160-7	0811	13-15			7.800
6160-8	0811	13-15		F	8.500
6159-12	0740	16-18			7.300
6159-11	0740	16-18		F	9.800
6170-19	1100	00	2	F	6.300
6170-16	1100	00	9		6.100
6171-1	1100	00	9	F	5.400
6170-15	1100	00	16		7.400
6170-17	1100	00	16	F	9.200
6170-6	1100	00	19		10.500
6170-11	1100	00	19	F	9.600
6170-5	1015	01	2		12.600
6170-3	1015	01	2	F	6.800
6170-10	1015	01	9		7.400
6170-2	1015	01	9	F	15.300
6170-18	1015	01	15		12.600
6170-13	1015	01	15	F	7.500
6171-3	1015	01	18		6.400
6170-14	1015	01	18	F	15.500
6170-4	1037	11	2		8.000
6171-2	1036	11	2	F	5.700
6170-12	1039	11	9		9.500
6171-4	1038	11	9	F	5.900
6170-1	1042	11	15		32.300
6170-20	1042	11	15	F	7.600
6170-7	1045	11	18		8.200
6170-9	1044	11	18	F	7.000
6181-19	1625	13-15			QNS
6181-18	1625	13-15		F	10.000
6181-16	1700	16-18			5.400
6181-17	1700	16-18		F	5.800

Table G40
TOC Levels for 08 August 92 - Dead Man's Creek - Toyo Pump

ARDL Number	Sample Time	Sample Station	Sample Depth, ft	Filter	TOC, mg/ℓ
6211-1	0831	13-15			7.800
6211-2	0831	13-15		F	8.200
6212-2	0742	16-18			8.300
6212-1	0742	16-18		F	11.600
6214-6	1345	01	2		6.800
6213-13	1345	01	2	F	10.400
6214-7	1345	01	10		7.500
6214-13	1345	01	10	F	8.000
6214-4	1345	01	17		7.200
6213-15	1345	01	17	F	8.400
6214-5	1345	01	21		7.800
6213-17	1345	01	21	F	7.900
6213-1	1306	11	3		8.600
6210-2	1305	11	3	F	7.400
6213-2	1308	11	13		7.700
6210-4	1307	11	13	F	8.000
6210-5	1310	11	21		7.600
6210-1	1309	11	21	F	7.000
6213-3	1312	11	25		7.900
6210-3	1311	11	25	F	7.800
6214-16	1613	13-15			6.100
6214-17	1613	13-15		F	7.600
6215-1	1655	16-18			6.700
6215-2	1655	16-18		F	7.300

Appendix H
Water Column Chemistry Extremes in Comparison to New York Department of Environmental Conservation Standards

Table H1
Opened Clamshell Bucket with Sediment Dispersion Barrier-Induced Water Column Chemical Extremes versus NYDEC Standards

Date	Station	Distance from Dredge	Time	Parameter	Maximum Value	NYDEC D-Std.	NYDEC B/C-Std.	NYDEC A-Std.
7/31	11	400	1644	Velocity	0.6	NS	NS	NS
7/30	5	200	1205	TSS[1]	112	NS	NS	NS
7/30	15	-3,300	1651	DO[2]	5.72	3	4	4
7/30	2/17	0/2,200	1510/1722	pH	6.35-8.13	6.5-8.5	6.5-8.5	6.5-8.5
7/30	18	2,200	1734	Temp.	21.1	32	32	32
7/31	11	400	1155	Nitro Amm	0.097	NS	NS	NS
7/30	1	100	1100	TOC	29.5	NS	NS	NS
7/30	11	400	1653	Chromium[3]	0.027(F)	2.341	0.012	0.012
7/30	13-15	-3,300	AM	Copper[3]	0.053(F)	0.025	0.016	0.016
7/30	1	100	1200	Lead[3]	0.079(F)	0.131	0.005	0.005
7/30	1	100	1200	Zinc[3]	0.26(F)	0.435	0.03	0.03
PCB's					All U's	NS[4]	NS[4]	NS[4]
PAH's					All U's	NS[4]	NS[4]	NS[4]

[1] Above background.
[2] Minimum value.
[3] Acid-soluble form and 144 mg/ℓ hardness.
[4] Standards apply to individual aroclors or compounds.

Table H2
Opened Clamshell Bucket-Induced Water Column Chemical Extremes versus NYDEC Standards

Date	Station	Distance from Dredge	Time	Parameter	Maximum Value	NYDEC D-Std.	NYDEC B/C-Std.	NYDEC A-Std.
7/31	13	-1,600	0826/0827	Velocity	1.3	NS	NS	NS
7/30	0	0	1515	TSS[1]	3,060	NS	NS	NS
7/30	17	1,000	0816	DO[2]	6.22	3	4	4
7/30	16/13	1,000/1,600	0802/1647	pH	7.25/8.01	6.5-8.5	6.5-8.5	6.5-8.5
7/30	1	200	1600	Temp.	18.5	32	32	32
7/31	1	200	1210	Nitro Amm	0.13	NS	NS	NS
7/30	0	0	1515	TOC	45.7	NS	NS	NS
7/30	13-15	-1,600	0843	Chromium[3]	0.017	2.341	0.012	0.012
7/30	0	0	1515	Copper[3]	0.093	0.025	0.016	0.016
7/30	0	0	1515	Lead[3]	0.19	0.131	0.005	0.005
7/30	16-18	1,000	0803	Zinc[3]	0.51	0.435	0.03	0.03
PCB's					All U's	NS[4]	NS[4]	NS[4]
PAH's					All U's	NS[4]	NS[4]	NS[4]

[1] Above background.
[2] Minimum value.
[3] Acid-soluble form and 144 mg/ℓ hardness.
[4] Standards apply to individual aroclors or compounds.

Table H3
Closed Clamshell Bucket-Induced Water Column Chemical Extremes versus NYDEC Standards

Date	Station	Distance from Dredge	Time	Parameter	Maximum Value	NYDEC D-Std.	NYDEC B/C-Std.	NYDEC A-Std.
8/4	15	1,400	1608	Velocity	2.3	NS	NS	NS
8/4	0	0	1030	TSS[1]	11,566	NS	NS	NS
8/3	1	200	1500	DO[2]	5.0	3	4	4
8/3	16/14	1,200/1,400	0744/0851	pH	7.15/8.28	6.5-8.5	6.5-8.5	6.5-8.5
8/3	11	600	1521	Temp.	22	32	32	32
8/3	11	600	1222	Nitro Amm	0.26	NS	NS	NS
8/4	13-15	1,400	0833	TOC	35.9(F)	NS	NS	NS
8/3	11	600	1224	Chromium[3]	0.42	2.314	0.012	0.012
8/4	11	600	1240	Copper[3]	0.28	0.025	0.016	0.016
8/4	16-18	1,200	0849	Lead[3]	0.47	0.131	0.005	0.005
8/4	11	600	1240	Zinc[3]	0.21	0.435	0.03	0.03
PCB's					All U's	NS[4]	NS[4]	NS[4]
PAH's					All U's	NS[4]	NS[4]	NS[4]

[1] Above background.
[2] Minimum value.
[3] Acid-soluble form and 144 mg/ℓ hardness.
[4] Standards apply to individual aroclors or compounds.

Table H4
Submersible Pump-Induced Water Column Chemical Extremes versus NYDEC Standards (Mobil Oil Refinery)

Date	Station	Distance from Dredge	Time	Parameter	Maximum Value	NYDEC D-Std.	NYDEC B/C-Std.	NYDEC A-Std.
8/7	11	600	0921	Velocity	0.3	NS	NS	NS
8/7	0(PT 6)	0	1117	TSS[1]	22,300	NS	NS	NS
8/7	1	200	0915	DO[2]	4.1	3	4	4
8/7	16/11	1,500/600	0735/1049	pH	7.48-8.41	6.5-8.5	6.5-8.5	6.5-8.5
8/7	1	200	0915/1530	Temp.	22	32	32	32
8/7	16-18	1,500	1700	Nitro Amm	0.21	NS	NS	NS
8/7	11	600	1042	TOC	32.3	NS	NS	NS
8/7	1	200	1015	Chromium[3]	0.016	2.341	0.012	0.012
8/7	16-18	1,500	0740-BD	Copper[3]	0.045	0.025	0.016	0.016
8/6	1	200	1530	Lead[3]	0.016	0.131	0.005	0.005
8/6	11	600	1550/1554	Zinc[3]	0.14	0.435	0.03	0.03
PCB's					All U's	NS[4]	NS[4]	NS[4]
PAH's					All U's	NS[4]	NS[4]	NS[4]

[1] Above background.
[2] Minimum value.
[3] Acid-soluble form and 144 mg/ℓ hardness.
[4] Standards apply to individual aroclors or compounds.

Table H5
Submersible Pump-Induced Water Column Chemical Extremes versus NYDEC Standards (Upstream Dead Man's Creek)

Date	Station	Distance from Dredge	Time	Parameter	Maximum Value	NYDEC D-Std.	NYDEC B/C-Std.	NYDEC A-Std.
8/8	11	800	1552	Velocity	0.5	NS	NS	NS
8/8	0(PT 6)	0	1010	TSS[1]	3,810	NS	NS	NS
8/8	1	100	0945	DO[2]	4.4	3	4	4
8/8	16/13	3,000/2,400	0748/1617	pH	6.98/7.9	6.5-8.5	6.5-8.5	6.5-8.5
8/8	1	100	0945/1530	Temp.	20	32	32	32
8/8	All Stations			Nitro Amm	<0.1	NS	NS	NS
8/8	1	100	1345	TOC	10.4(F)	NS	NS	NS
8/8	All Stations			Chromium[3]	<0.008	2.341	0.012	0.012
8/8	11	800	1310	Copper[3]	0.013	0.025	0.016	0.016
8/8	11	800	1306	Lead[3]	0.012	0.131	0.005	0.005
8/8	13-15	2,400	0831	Zinc[3]	0.094	0.435	0.03	0.03
PCB's					All U's	NS[4]	NS[4]	NS[4]
PAH's					All U's	NS[4]	NS[4]	NS[4]

[1] Above background.
[2] Minimum value.
[3] Acid-soluble form and 144 mg/ℓ hardness.
[4] Standards apply to individual aroclors or compounds.

Appendix I
Sealogger Water Column Data and Observations

Field support for the Buffalo River environmental dredging demonstration project was provided by J. Singer and five Buffalo State College (BSC) undergraduate students. Singer and the students collected water column samples (for analysis by the Great Lakes Laboratory at BSC and Applied Research and Development Laboratory, Inc. (ARDL) and measured current velocity and selected water quality parameters. The sampling sites are identified in the workplan prepared by the U.S. Army Engineer Waterways Experiment Station. J. Singer and P. Manley also conducted three side-scan sonar surveys of the two dredged sites (one survey conducted before dredging began, two surveys conducted after dredging was completed). This appendix summarizes the current velocity data and water column data.

Current Velocity and Water Column Profiling Interpretation

The current velocity was measured using a Marsh-McBirney portable current meter. Measurements were made at 1-ft increments in the upper 6 ft of the water columns and at 2-ft increments below 6 ft. The velocity data are in feet per second. Reverse flow is indicated by a negative value for the velocity. No velocity readings were taken in the late afternoon on August 8, 1992, at site 18 due to a thunderstorm.

A SeaBird Sealogger water column profiler contains an array of sensors used to measure pressure (pounds per square inch), depth (feet), temperature (degrees Fahrenheit), conductivity (siemens per meter), pH, percent transmission of light, irradiance (photosynthetically active radiation (PAR)), fluorescence, and dissolved oxygen (milligrams per liter). Each of these parameters is measured eight times per second as the Sealogger is lowered and raised through the water column. This information is averaged into 0.25-sec intervals and stored internally. At the end of each day, the data are transferred from the Sealogger to disk. Using software provided by SeaBird Electronics,

the data are converted to ASCII format to facilitate the processing of the data (converted Sealogger files have the extension "ASC"). The water column data include the nine parameters listed above. A scan number is also included with each line of data. Because the sensors equilibrate just below the water surface for approximately 2 min before the Sealogger is lowered through the water column, these scans (usually the first 500 or so) have been excluded from each data set. The Sealogger file names in this report are prefixed by a "D" to indicate that the file contains downcast data only. At the Mobil Oil site, no Sealogger profiles were collected at site 15 (an upstream site) due to the shallow water depth (<8 ft).

The transmissometer (used to measure the percent transmission of light, an indicator of water turbidity) and fluorometer (used to measure fluorescence, an indicator of chlorophyll and productivity) were "off-scale" (i.e., exceeded working limits of the sensors) in some of the profiles. When the transmissometer is off-scale, a negative value is given (ex., -0.02); a value of 1.000 e+01 indicates that the fluorometer is off-scale. The working ranges of both of these sensors are exceeded when the water column contains very high amounts of suspended solids. Although the fluorometer is looking at specific wavelengths associated with chlorophyll, high sediment concentrations in the water column can overwhelm the sensor. The working limits of the transmissometer and fluorometer were exceeded several times during the dredging demonstration project following periods of heavy rainfall and runoff.

Irradiance, expressed as PAR (photosynthetically active radiation) values, is measured using a LiCor spherical quantum sensor. The PAR sensor, in addition to the tranmissometer, provides an indication of water turbidity. The PAR sensor is mounted on the upper end of the Sealogger (in order to prevent it from being "shaded" by other sensors). The Sealogger is approximately 3 ft high and therefore the first few scans provide PAR values in air (i.e., PAR sensor is above the water surface when all the other sensors are below the water surface). The PAR values in water begin when the depth is approximately 3 ft. The limit of the euphotic zone is defined as 1 percent of the PAR value at the water surface. For example, on 27 July 1992, 7:42 AM, site 16, the PAR value at 2.8 ft is 1.985e+00. At a depth of 4.7 ft, the PAR value is approximately 1 percent of the value at 2.8 ft; the euphotic zone extends down to approximately this depth.

The following is a summary of the water column data collected during the demonstration project.

July 27, 1992 (Dead Man's Creek site)

a. The temperature is fairly uniform throughout the water column and ranges from 65 to 67 °F.

b. The percent transmission of light is near the maximum for the sensor; the fluorometer also is near the upper end of its working limit.

c. There does not appear to be any mixing between lake and river water (no reverse flow noted).

July 28, 1992 (Dead Man's Creek site)

a. The water column was fairly uniform with respect to temperature (65.5 to 66 °F) during the morning profiling at both the downstream sites (16, 17, and 18) and upstream sites (13, 14, and 15). The transmissometer was at, or exceeded, its working limits at the downstream and upstream sites.

b. The water column at site 11 generally was uniform with respect to the measured parameters throughout the day.

c. Afternoon profiling at the downstream sites (16, 17, and 18) shows that the upper 8 to 10 ft of the water column have a higher temperature (68 to 70 °F), higher conductivity (>0.022), and lower turbidity (lt $\% > 10$) compared to the lower portion of the water column. This may indicate that a layer of lake water is flowing over river water (although no flow reversal was noted).

July 29, 1992 (Dead Man's Creek site)

a. Morning profiling at the upstream and downstream sites shows fairly uniform water temperature (66 to 67 °F) throughout the water column. The upper portion of the water column at the downstream sites (16, 17, and 18) has higher transmissometer values (>10 percent light transmission) compared to both the lower part of the water column and to the upstream sites (13, 14, and 15). The percent transmission of light at the upstream sites is <10 percent throughout the water column.

b. The water column throughout the day at site 11 generally was uniform with respect to temperature, conductivity, and pH.

c. Afternoon profiling at the downstream sites (16, 17, and 18) shows that the upper 10 to 12 ft of the water column are less turbid ($>10\%$ transmission of light) compared to the lower portion of the water column. The upstream sites (13, 14, and 15) exhibit a somewhat higher percent light transmission in the upper part of the water column as well, but overall the values are much lower compared to sites 16, 17, and 18. This may reflect some surface flow of lake water upstream as far as sites 16, 17, and 18, but not as far upstream as sites 13, 14, and 15.

July 30, 1992 (Mobil Oil site)

a. The entire water column appears to be fairly uniform with respect to the measured parameters.

b. The transmissometer and fluorometer both are very close to their working limits.

July 31, 1992 (Mobil Oil site)

a. Morning profiles at the downstream sites (16, 17, and 18) show a warmer (63 to 64 °F) and lower turbidity (>10 percent light transmission) surface layer compared with the upstream sites (13, 14; 61 °F, transmissometer values near or above its working limit). This difference may indicate some influence of lake water at the downstream sites.

b. The three profiles collected at sites 11/12 show that the water column generally is uniform with temperatures near 61 °F. An exception to this is at site 11, 10:17 AM, in which there is a higher temperature, higher conductivity bottom layer (temperature and conductivity values are characteristic of lake water). The transmissometer and fluorometer are at, or exceed, their working limits.

c. Afternoon profiling at the upstream site (13) and downstream sites (16, 17, and 18) shows a uniform water column with respect to the measured parameters; the transmissometer exceeds its working limit.

Notes: Due to an oily film at site 11, to prevent fouling of the sensors the Sealogger profile collected at 12:30 PM was taken at site 12 instead of site 11. No Sealogger profile was collected at site 14 in the afternoon due to large branches moving downstream. During the afternoon sampling at the downstream sites (16, 17, and 18) the tug was repositioning; it appeared that some of the debris caught at the upstream end of the tug was released and carried past the downstream sampling sites.

August 1, 1992 (Mobil Oil site)

a. There is a temperature difference of several degrees between the morning (60 °F) and afternoon (63 to 64 °F) profiles for all of the sites (upstream and downstream and at site 11). There also is a slight increase in the percent transmission of light between the morning and afternoon profiling.

Note: File names for Sealogger data go from DWES605 to DWES612; DWES606 to DWES611 are not part of the dredging demonstration data set.

August 3, 1992 (Mobil Oil site)

a. Throughout the day, the water column is stratified with respect to temperature. The temperature of the upper portion of the water column is 69 to 72 °F, the temperature of the lower portion of the water column is 67 to 68 °F.

b. The morning profiles collected at the upstream and downstream sites show an increase in the level of turbidity below 10 ft, with values decreasing from greater than 15 percent light transmission to values less than 10 percent.

c. Afternoon profiles at the upstream sites (13 and 14) indicate light transmission greater than 20 percent throughout the water column. The afternoon profiles at the downstream sites (16, 17, 18, and site 11) have lower values for light transmission at depths below 3 ft. This difference may reflect the resuspension of bottom sediments during dredging operations.

August 4, 1992 (Mobil Oil site)

a. Morning profiles at the downstream sites (16, 17, and 18) show some variability in transmissometer values, with site 16 having lower values than sites 17 and 18. The temperature (67 and 68 °F) profiles at all three downstream sites are similar. Morning profiling at the upstream sites (13 and 14) shows two layers in the water column with respect to conductivity (>0.033 to <0.033) and percent transmission of light (values >10 percent to values <10 percent).

b. The afternoon profiles for all of the sites show a decrease in temperature (63 °F) and an increase in turbidity compared to the morning profiles. In several of the afternoon profiles, the transmissometer and fluorometer both exceed their working limits. Because these changes in the water column are noted at both the upstream and downstream sites, the increase in turbidity appears to be the result of rainfall runoff from the tributaries, and not the result of dredging operations.

August 5, 1992 (Mobil Oil site)

a. The water column profiles for the upstream and downstream sites (morning only) appear to be uniform with respect to temperature (~61 °F) and conductivity (0.018 to 0.019).

b. **Note:** There is no additional profiling on this day due to changing the dredging equipment (closed bucket to suction type dredge).

August 6, 1992 (Mobil Oil site)

a. Morning profiles for the downstream sites (16, 17, and 18) show a slight decrease in temperature (from 67 to 65 °F) between the upper and lower parts of the water column. This difference is most apparent in the profile for site 16 taken at 7:35 AM. There also appears to be an increase in turbidity with increasing depth. Conductivity, dissolved oxygen, and pH appear fairly uniform. The temperature of the water column at the upstream sites (13 and 14) is slightly lower (63.5 to 64 °F) and the percent transmission of light is slightly higher compared to the downstream sites.

b. At site 11 the percent transmission of light decreases through the water column from values >10 percent to values <10 percent. Also, at site 11, the water column is stratified with respect to temperature, with temperatures in the upper layer ranging from 65 to -70 °F and from 63 to 65 °F in the lower layer.

c. Afternoon profiles for the two upstream sites (13 and 14) and the three downstream sites (16, 17, and 18) show that the water column is stratified with respect to temperature. The downstream sites also have a higher turbidity compared to the upstream sites.

d. **Note:** Replicate Sealogger profiles are included in the data set for site 14.

August 7, 1992 (Mobil Oil site)

a. The morning profiles for all sites (upstream and downstream) show a decrease in temperature from the surface to the bottom of the water column, with temperatures of 69 to 70 °F within the upper part of the water column and temperatures several degrees less in the lower portion of the water column. The lower few feet of the water column also has a higher turbidity (values <5 percent) compared to the rest of the water column (values >10 percent).

b. Throughout the day at site 11 the water column is stratified with respect to temperature. The upper portion of the water column has higher values for percent transmission of light compared to the lower portion of the water column. The difference is well-defined with values >15 percent light transmission in the upper water column and values <5 percent in the lower portion of the water column.

Table I1
Date: 27 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0946	3	1.28	65.5	0.021	7.94	-0.02	0.039	8.07	6.86
13	0946	12	5.21	65.3	0.020	7.93	-0.05	0.011	8.44	7.57
13	0946	19	8.18	65.2	0.020	7.95	-0.05	0.011	8.99	7.55
14	1008	3	1.36	65.5	0.021	7.91	-0.02	0.033	8.47	8.32
14	1008	14	6.02	65.3	0.020	7.92	-0.02	0.013	8.93	8.49
14	1008	22	9.58	65.2	0.019	7.95	-0.02	0.012	9.28	8.51
15	1030	3	1.39	65.5	0.019	7.91	-0.05	0.028	8.83	6.86
15	1030	13	5.57	65.3	0.019	7.91	-0.02	0.013	9.16	7.79
15	1030	20	8.71	65.2	0.019	7.92	-0.05	0.012	9.22	7.92
11	1504	3	1.28	66.2	0.021	7.23	-0.05	0.058	7.53	8.17
11	1504	13	5.63	65.6	0.020	7.92	-0.02	0.017	8.11	8.41
11	1504	21	9.13	65.3	0.019	7.94	-0.05	0.016	8.43	8.56
16	0742	3	1.36	67.1	0.027	7.77	2.55	1.13	5.07	7.68
16	0742	12	5.15	67.0	0.027	7.80	1.57	0.019	5.25	8.03

(Continued)

Table I1 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
16	0742	19	8.26	66.9	0.027	7.84	1.18	0.017	5.48	8.07
17	0826	3	1.28	66.8	0.027	7.92	1.37	0.552	5.24	7.48
17	0826	14	6.07	66.8	0.027	7.92	0.76	0.014	5.57	7.93
17	0826	22	9.52	66.7	0.026	7.94	0.54	0.014	5.84	8.08
18	0853	3	1.34	66.8	0.027	7.91	1.62	0.773	5.07	7.90
18	0853	11	4.71	66.6	0.026	7.92	0.59	0.015	5.61	8.05
11	1703	3	1.23	66.3	0.019	7.90	-0.02	0.049	7.96	8.49
11	1703	13	5.68	65.4	0.019	7.90	-0.02	0.016	8.23	8.53
11	1703	22	9.60	65.3	0.019	7.92	-0.05	0.015	8.50	8.46

Table I2

Date: 28 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0818	3	1.28	65.7	0.021	7.79	0.17	0.011	6.69	6.75
13	0818	12	5.21	65.8	0.021	7.79	0.12	0.011	6.88	7.13
13	0818	19	8.21	65.8	0.021	7.80	0.12	0.010	6.85	7.51
14	0831	3	1.31	65.8	0.021	7.79	0.12	0.114	6.60	7.93
14	0831	14	6.13	65.8	0.021	7.80	0.12	0.010	6.74	7.89
14	0831	21	9.13	65.8	0.021	7.81	0.15	0.010	6.70	7.92
15	0843	3	1.28	65.8	0.021	7.80	0.17	0.122	6.12	6.77
15	0843	14	6.02	65.8	0.021	7.80	0.17	0.010	6.80	6.88
15	0843	21	9.08	65.8	0.021	7.82	0.15	0.010	6.82	6.79
11	0923	3	1.28	65.7	0.020	7.79	0.03	0.079	6.99	7.09
11	0923	13	5.57	65.7	0.020	7.79	0.03	0.010	7.14	7.49
11	0923	22	9.55	65.7	0.020	7.81	0.00	0.010	7.22	7.57
16	0721	3	1.28	65.5	0.020	7.42	0.00	0.053	7.10	7.23
16	0721	12	5.15	65.6	0.020	7.46	0.03	0.014	7.40	7.47

(Sheet 1 of 4)

Table I2 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
16	0721	19	8.21	65.5	0.020	7.53	-0.02	0.013	7.59	7.57
17	0738	3	1.28	65.5	0.020	7.71	0.00	0.059	7.07	6.21
17	0738	21	9.08	65.5	0.020	7.75	0.00	0.010	7.22	7.44
18	0750	3	1.26	65.5	0.020	7.74	0.08	0.088	6.90	6.90
18	0750	12	5.15	65.5	0.020	7.74	0.00	0.011	7.19	7.39
18	0750	19	8.18	65.6	0.020	7.76	0.00	0.010	7.44	7.58
11	1200	3	1.36	65.9	0.021	7.83	0.15	0.199	6.12	7.48
11	1200	13	5.68	65.8	0.020	7.81	0.10	0.012	6.41	7.58
11	1200	22	9.58	65.7	0.020	7.83	0.00	0.011	6.58	7.63
13	1628	3	1.36	67.6	0.022	7.83	1.49	2.56	5.69	6.58
13	1628	13	5.63	66.6	0.021	7.83	1.54	0.018	5.66	7.44
13	1628	20	8.68	66.2	0.021	7.84	1.15	0.017	5.76	8.14
13	1628	12	5.23	66.7	0.022	7.83	1.57	0.019	5.70	7.47
13	1628	19	8.29	66.3	0.021	7.84	1.20	0.017	5.75	8.14

(Sheet 2 of 4)

Table I2 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
14	1638	3	1.31	67.3	0.022	7.81	1.44	3.94	5.65	8.05
14	1638	14	6.13	66.3	0.021	7.82	1.44	0.014	5.69	8.13
14	1638	20	8.73	65.9	0.021	7.83	0.86	0.014	5.72	8.06
14	1638	21	9.13	65.9	0.021	7.83	0.81	0.014	5.74	8.01
15	1651	3	1.36	67.4	0.022	7.80	1.27	2.24	5.85	5.72
15	1651	13	5.63	66.4	0.021	7.80	1.52	0.016	5.71	7.19
15	1651	20	8.71	65.9	0.021	7.83	1.13	0.015	5.74	6.95
15	1651	12	5.26	66.5	0.021	7.81	1.54	0.017	5.71	7.12
15	1651	18	7.86	66.2	0.021	7.82	1.15	0.015	5.74	7.16
11	1521	3	1.26	66.2	0.021	7.83	0.27	0.773	5.57	7.80
11	1521	13	5.56	65.9	0.021	7.80	0.17	0.017	5.92	7.84
11	1521	22	9.60	65.9	0.021	7.80	0.12	0.016	5.95	7.79
16	1712	3	1.34	69.8	0.025	8.10	26.6	33.6	5.09	8.19
16	1712	12	5.23	66.5	0.021	8.09	1.00	0.081	4.53	8.75

(Sheet 3 of 4)

Table I2 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
16	1712	19	8.31	65.8	0.021	8.01	0.37	0.016	5.52	7.69
17	1722	3	1.28	70.1	0.025	8.13	28.6	70.8	4.96	6.83
17	1722	14	6.07	66.1	0.021	8.07	0.56	0.023	5.15	7.70
17	1722	21	9.05	65.9	0.021	7.99	0.20	0.014	5.78	8.03
18	1734	3	1.28	70.2	0.024	8.13	30.2	55.5	4.75	6.39
18	1734	12	5.26	66.2	0.021	8.06	1.27	0.044	4.86	7.81
18	1734	18	7.76	66.0	0.021	8.00	0.47	0.015	5.51	8.19

(Sheet 4 of 4)

Table I3

Date: 29 July 92 - Dead Man's Creek - Clamshell Dredge (Open Bucket)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0820	3	1.26	66.8	0.022	7.65	7.83	2.72	5.10	7.79
13	0820	14	6.02	66.6	0.022	7.68	5.31	0.014	5.24	7.52
13	0820	21	9.10	66.3	0.022	7.70	4.23	0.012	5.28	7.45
14	0830	3	1.31	66.9	0.022	7.75	7.95	4.45	4.99	6.08
14	0830	14	6.07	66.7	0.022	7.76	6.24	0.013	5.04	7.43
14	0830	20	8.71	66.6	0.022	7.77	5.53	0.012	5.12	7.36
15	0841	3	1.36	66.7	0.022	7.76	7.95	2.08	5.02	6.39
15	0841	13	5.67	66.4	0.022	7.75	4.75	0.014	5.16	7.23
15	0841	20	8.63	66.3	0.022	7.76	3.21	0.012	5.29	7.20
11	0932	3	1.31	66.7	0.022	7.74	8.83	2.37	4.89	6.99
11	0932	13	5.63	66.7	0.022	7.75	7.29	0.013	4.97	7.44
11	0932	21	9.08	66.7	0.022	7.78	7.19	0.011	4.99	7.49
16	0722	3	1.34	67.9	0.023	7.28	23.8	5.21	3.89	7.43
16	0722	12	5.15	66.7	0.022	7.34	14.4	0.028	4.05	7.79

(Sheet 1 of 4)

Table I3 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
16	0722	19	8.29	66.5	0.021	7.38	6.29	0.017	4.71	7.53
17	0733	3	1.28	67.6	0.023	7.63	19.2	4.95	4.09	7.65
17	0733	14	6.07	67.0	0.022	7.66	10.5	0.016	4.55	7.63
17	0733	21	9.13	66.6	0.022	7.68	8.85	0.013	4.70	7.63
18	0751	3	1.34	67.9	0.023	7.75	25.8	3.29	3.95	8.25
18	0751	12	5.18	67.1	0.022	7.76	16.1	0.023	4.11	6.35
18	0751	19	8.29	66.7	0.022	7.77	9.90	0.013	4.51	6.56
11	1128	3	1.28	66.9	0.022	7.75	16.8	0.0	4.58	7.57
11	1128	13	5.65	66.7	0.022	7.75	10.1	0.017	4.64	7.53
11	1128	22	9.55	66.6	0.022	7.78	8.51	0.012	4.82	7.60
13	1440	3	1.36	67.4	0.023	7.77	10.9	6.21	4.81	7.00
13	1440	12	5.23	67.0	0.022	7.78	8.85	0.018	4.82	7.01
13	1440	19	8.29	66.9	0.022	7.78	7.63	0.012	4.87	6.72
14	1450	3	1.28	67.3	0.023	7.80	11.0	5.99	5.19	7.39

(Sheet 2 of 4)

Table I3 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
14	1450	14	6.05	67.0	0.022	7.79	9.20	0.014	4.89	7.28
14	1450	21	9.05	66.5	0.022	7.80	5.70	0.011	4.97	7.16
15	1500	3	1.31	67.3	0.023	7.79	11.3	2.46	5.05	7.09
15	1500	12	5.21	66.9	0.022	7.78	8.63	0.016	4.96	7.06
15	1500	19	8.26	66.7	0.022	7.79	6.65	0.013	4.99	7.26
11	1420	3	1.23	67.0	0.022	7.55	9.34	29.7	4.47	7.36
11	1420	14	6.05	66.7	0.022	7.61	7.68	0.015	4.68	7.40
11	1420	23	9.92	66.6	0.022	7.65	8.49	0.012	4.70	7.39
16	1519	3	1.28	67.7	0.023	7.84	29.9	44.3	5.71	7.54
16	1519	12	5.18	66.9	0.022	7.83	12.5	0.060	4.50	7.64
16	1519	19	8.23	66.7	0.022	7.83	6.21	0.014	4.71	7.22
17	1529	3	1.28	67.7	0.022	7.85	30.6	63.0	5.33	7.76
17	1529	14	6.07	66.8	0.022	7.83	8.56	0.032	4.73	7.36
17	1529	21	9.05	66.7	0.022	7.82	6.02	0.014	4.80	7.26

(Sheet 3 of 4)

Table I3 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
18	1545	3	1.26	68.0	0.023	7.92	31.7	48.7	5.03	7.91
18	1545	12	5.26	66.8	0.022	7.87	10.9	0.043	4.53	7.63
18	1545	19	8.23	66.8	0.022	7.85	7.78	0.015	4.64	7.29

(Sheet 4 of 4)

Table I4
Date: 30 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0842	3	1.31	63.0	0.021	7.83	0.10	0.060	8.84	9.08
13	0842	10	4.34	63.0	0.021	7.84	0.12	0.010	8.93	9.10
13	0842	15	6.44	63.0	0.021	7.85	0.12	0.008	8.88	9.08
14	0857	3	1.31	63.0	0.021	7.86	0.10	0.090	8.92	9.00
14	0857	10	4.36	63.0	0.021	7.87	0.12	0.010	8.97	9.02
14	0857	15	6.47	63.0	0.021	7.88	0.12	0.009	8.74	9.05
15	0906	3	1.28	63.1	0.020	7.87	0.05	0.118	9.05	8.88
15	0906	6	2.57	63.0	0.021	7.87	0.03	0.020	9.31	8.96
11	1301	2	0.916	62.9	0.021	7.75	0.64	22.2	6.52	9.33
11	1301	9	3.86	62.8	0.021	7.76	0.44	0.022	7.27	9.76
11	1301	15	6.52	62.7	0.021	7.80	0.27	0.017	7.71	9.83
16	0802	3	1.31	63.5	0.021	7.25	0.03	0.056	9.15	8.63
16	0802	10	4.34	63.6	0.021	7.33	-0.02	0.011	9.49	8.72
16	0802	15	6.47	63.6	0.021	7.38	-0.02	0.010	9.48	8.83

(Sheet 1 of 3)

Table I4 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
17	0816	3	1.23	63.7	0.021	7.70	0.00	0.072	9.29	6.22
17	0816	10	4.39	63.5	0.021	7.73	-0.02	0.010	9.42	7.80
17	0816	15	6.49	63.5	0.021	7.75	0.00	0.008	9.49	8.31
18	0829	3	1.31	63.6	0.021	7.74	0.00	0.073	9.18	6.79
18	0829	10	4.36	63.6	0.021	7.77	0.00	0.010	9.46	7.80
11	1504	2	0.916	63.9	0.022	7.91	1.13	15.0	6.58	9.35
11	1504	9	3.92	63.1	0.022	7.91	0.91	0.018	7.25	9.30
11	1504	15	6.55	63.1	0.022	7.92	0.56	0.013	7.55	9.29
13	1647	3	1.36	64.5	0.023	7.98	1.86	1.18	7.08	8.67
13	1647	10	4.36	64.6	0.023	8.00	1.86	0.014	7.07	8.99
13	1647	15	6.49	64.5	0.023	8.01	1.88	0.011	7.14	8.99
14	1659	3	1.28	64.4	0.023	7.97	1.66	1.86	6.91	9.07
14	1659	10	4.31	64.3	0.024	7.98	2.11	0.015	6.82	8.95

(Sheet 2 of 3)

Table I4 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
11	1615	2	0.811	63.9	0.023	7.95	1.42	0.119	6.82	7.82
11	1615	9	3.92	63.6	0.022	7.94	1.03	0.017	7.00	8.34
11	1615	15	6.52	63.4	0.023	7.95	0.42	0.012	7.30	9.14
16	1721	3	1.26	64.3	0.023	7.90	1.69	1.27	6.64	8.21
16	1721	10	4.39	63.8	0.023	7.91	1.22	0.014	6.97	8.43
17	1735	3	1.31	64.2	0.023	7.91	1.96	1.65	6.77	9.13
17	1735	10	4.31	63.8	0.023	7.91	1.35	0.015	6.98	9.13
17	1735	15	6.55	63.5	0.023	7.92	0.61	0.011	7.38	9.08
18	1744	3	1.26	64.3	0.023	7.91	1.74	1.39	6.69	9.13
18	1744	15	6.52	63.7	0.023	7.93	0.96	0.011	7.16	9.07

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Table I5

Date: 31 July 92 - Mobil Oil - Clamshell Dredge (Open Bucket)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0822	3	1.36	61.7	0.021	7.88	0.10	0.035	6.43	7.28
13	0822	10	4.31	61.6	0.021	7.88	0.10	0.009	6.61	7.38
13	0822	15	6.47	61.6	0.021	7.90	0.05	0.008	6.51	7.47
14	0852	3	1.23	61.4	0.021	7.85	-0.02	0.034	7.24	8.07
14	0852	10	4.39	61.3	0.021	7.86	-0.02	9.63	7.36	8.65
11	1017	2	0.837	61.1	0.020	7.84	0.03	0.182	6.72	8.84
11	1017	9	3.86	61.0	0.020	7.85	-0.05	0.011	7.15	8.87
11	1017	15	6.44	61.0	0.020	7.86	-0.05	0.008	7.26	8.95
16	0733	3	1.26	64.2	0.026	7.39	11.1	0.982	4.39	6.77
16	0733	10	4.28	63.8	0.025	7.47	11.0	0.016	4.45	7.42
17	0741	3	1.23	64.0	0.025	7.64	13.9	1.18	3.97	8.61
17	0741	10	4.39	63.8	0.025	7.69	13.1	0.015	4.24	8.61
17	0741	15	6.44	63.7	0.025	7.72	12.2	0.010	4.38	8.68
18	0747	3	1.36	63.7	0.025	7.76	11.6	1.00	4.30	8.45
18	0747	11	4.81	63.6	0.025	7.79	11.4	0.012	4.46	8.51
18	0747	17	7.36	63.5	0.025	7.83	3.72	0.008	4.63	8.60

Table I6
Date: 31 July 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	1558	3	1.26	60.9	0.019	7.86	-0.05	0.025	8.44	9.24
13	1558	10	4.34	60.9	0.019	7.86	-0.05	0.009	8.85	9.27
13	1558	15	6.52	60.9	0.019	7.88	-0.05	0.008	9.03	9.15
11	1520	2	0.916	60.8	0.019	7.86	-0.05	0.036	9.18	8.27
11	1520	9	3.97	60.8	0.019	7.86	-0.05	0.010	9.68	8.72
11	1520	15	6.49	60.8	0.019	7.87	-0.05	0.008	9.96	8.73
16	1649	3	1.26	60.8	0.020	7.74	0.00	0.031	7.94	9.05
16	1649	10	4.31	60.9	0.020	7.75	-0.05	0.010	8.63	9.11
16	1649	15	6.47	60.9	0.020	7.77	-0.02	0.009	8.89	9.03
17	1708	3	1.23	60.9	0.020	7.81	-0.02	0.033	8.16	9.11
17	1708	8	3.52	60.8	0.020	7.81	-0.05	0.011	8.80	9.15
17	1708	11	4.73	60.8	0.020	7.82	-0.02	0.009	8.93	9.12
18	1722	3	1.36	60.8	0.020	7.75	-0.05	0.024	8.38	8.01
18	1722	5	2.13	60.8	0.020	7.75	-0.02	0.015	8.51	8.21
18	1722	8	3.49	60.8	0.020	7.75	-0.02	0.010	8.81	7.72

Table I7
Date: 01 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0820	3	1.31	59.6	0.020	7.85	0.08	0.183	6.72	8.90
13	0820	11	4.76	59.6	0.020	7.87	0.12	0.011	6.96	9.33
13	0820	17	7.36	59.8	0.020	7.88	0.00	0.009	7.49	9.49
14	0836	3	1.28	59.9	0.020	7.85	-0.02	0.051	8.05	8.80
14	0836	10	4.36	59.9	0.020	7.86	0.00	0.011	8.11	9.30
14	0836	15	6.47	59.8	0.020	7.87	0.00	0.009	8.10	9.20
11	0924	2	0.916	59.8	0.020	7.86	0.05	0.388	7.02	5.88
11	0924	9	3.92	59.8	0.020	7.86	0.05	0.012	7.20	9.04
11	0924	15	6.44	59.8	0.020	7.88	0.03	0.009	7.46	8.55
16	0744	3	1.23	59.9	0.020	7.15	0.00	0.068	7.65	9.42
16	0744	10	4.28	59.9	0.020	7.22	-0.05	0.013	8.31	9.40
16	0744	15	6.49	59.9	0.020	7.28	-0.05	0.011	8.79	9.39
17	0757	3	1.23	59.9	0.020	7.72	0.00	0.101	7.21	8.45
17	0757	10	4.34	59.9	0.020	7.73	-0.02	0.011	7.66	8.57
17	0757	15	6.52	59.9	0.020	7.75	-0.05	0.009	7.71	9.02

(Sheet 1 of 3)

Table I7 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
18	0808	3	1.21	59.9	0.020	7.78	-0.02	0.059	7.68	9.36
18	0808	11	4.78	59.9	0.020	7.80	-0.02	0.010	7.88	9.36
18	0808	17	7.39	60.0	0.020	7.81	-0.02	0.009	8.03	9.40
11	1229	2	0.863	60.5	0.021	7.99	0.74	17.7	5.71	9.98
11	1229	9	3.81	60.4	0.021	7.96	0.66	0.023	5.91	9.93
11	1229	15	6.57	60.4	0.021	7.97	0.52	0.018	6.04	9.98
13	1618	3	1.31	64.5	0.023	7.87	4.87	14.6	4.49	9.18
13	1618	10	4.28	64.2	0.023	7.88	4.65	0.031	4.72	9.48
13	1618	15	6.44	63.9	0.023	7.90	3.25	0.020	5.04	9.54
14	1631	3	1.34	64.1	0.023	7.96	4.97	12.9	4.48	9.65
14	1631	8	3.44	63.9	0.023	7.94	3.23	0.054	4.99	9.62
14	1631	12	5.18	63.9	0.023	7.95	2.99	0.019	5.33	9.40
11	1545	2	0.837	63.1	0.022	7.30	2.77	65.2	4.68	9.99
11	1545	9	3.89	62.8	0.022	7.36	1.96	0.030	5.02	9.91
11	1545	15	6.55	62.6	0.022	7.42	1.74	0.019	5.28	9.99
16	1649	3	1.31	63.8	0.023	7.91	4.06	2.94	4.72	9.10

(Sheet 2 of 3)

Table I7 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
16	1649	10	4.39	63.6	0.023	7.92	3.52	0.023	5.02	9.24
16	1649	15	6.52	63.3	0.023	7.93	1.42	0.017	5.34	9.45
17	1706	3	1.31	63.9	0.023	7.89	1.66	1.73	5.06	8.98
17	1706	10	4.28	63.9	0.023	7.91	1.69	0.021	5.43	9.22
17	1706	15	6.57	63.9	0.023	7.91	0.81	0.018	5.69	9.13
18	1715	3	1.34	64.1	0.023	7.90	1.71	1.56	5.40	9.15
18	1715	10	4.28	64.0	0.023	7.90	1.71	0.020	4.50	9.20
18	1715	15	6.52	64.0	0.023	7.91	1.66	0.018	5.57	9.32

(Sheet 3 of 3)

Table I8
Date: 03 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0840	3	1.28	70.5	0.033	8.24	27.5	11.7	3.17	7.85
13	0840	10	4.26	70.1	0.034	8.21	14.2	0.155	3.40	7.86
13	0840	15	6.55	67.8	0.034	8.18	5.75	0.022	3.86	8.10
14	0851	3	1.31	70.6	0.033	8.28	29.5	8.93	3.05	7.37
14	0851	8	3.52	70.0	0.033	8.27	29.3	0.441	3.14	7.81
14	0851	12	5.26	69.6	0.034	8.22	7.58	0.048	3.64	7.89
11	1007	2	0.863	70.1	0.033	8.16	9.73	42.7	3.47	7.78
11	1007	9	3.92	69.7	0.033	8.13	5.85	0.048	3.78	7.85
11	1007	15	6.44	68.3	0.032	8.08	3.72	0.018	4.00	7.95
16	0805	3	1.23	69.9	0.032	7.94	20.9	13.9	3.29	7.93
16	0805	10	4.42	69.5	0.032	7.95	15.5	0.067	3.46	8.01
16	0805	15	6.49	68.7	0.032	7.94	11.2	0.021	3.69	8.02
17	0814	3	1.36	70.1	0.032	8.10	20.1	5.04	3.32	8.07
17	0814	10	4.28	69.5	0.032	8.09	16.5	0.054	3.43	8.06
17	0814	15	6.52	67.4	0.031	8.07	12.6	0.019	3.62	8.28

(Sheet 1 of 3)

Table I8 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
18	0822	3	1.23	69.9	0.032	8.14	18.9	0.108	3.30	7.92
18	0822	10	4.42	69.1	0.032	8.11	14.6	0.060	3.47	8.03
11	1229	2	0.837	70.1	0.033	8.14	17.9	46.0	3.39	7.89
11	1229	9	3.84	69.5	0.033	8.12	11.2	0.128	3.52	7.84
11	1229	15	6.55	67.6	0.032	8.05	1.03	0.022	4.15	7.85
13	1653	3	1.31	69.0	0.035	8.09	29.7	59.1	3.81	8.09
13	1653	10	4.34	68.0	0.034	8.04	25.6	0.929	3.25	8.18
14	1705	3	1.36	69.9	0.035	8.09	30.8	21.7	3.52	8.02
14	1705	8	3.42	68.5	0.035	8.07	30.3	1.44	3.20	8.15
11	1521	2	0.916	71.6	0.034	8.13	14.6	61.6	3.60	7.79
11	1521	9	3.97	70.0	0.034	8.07	2.13	0.064	3.90	7.95
11	1521	15	6.55	69.3	0.034	8.02	1.40	0.026	4.25	7.47
16	1559	3	1.28	70.6	0.034	8.10	10.5	15.9	3.81	7.73
16	1559	9	3.97	69.6	0.034	8.04	2.37	0.049	3.94	7.71
16	1559	15	6.47	67.4	0.032	7.99	1.91	0.026	4.16	7.35
17	1615	3	1.26	70.4	0.034	8.08	13.0	23.6	3.75	7.78

(Sheet 2 of 3)

Table 18 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
17	1615	10	4.34	69.1	0.034	8.03	7.61	0.044	3.77	7.74
17	1615	15	6.57	68.2	0.033	8.00	2.42	0.026	3.89	7.54
18	1624	3	1.23	70.1	0.034	8.06	9.81	35.0	3.37	7.65
18	1624	10	4.34	69.4	0.034	8.01	7.46	0.039	3.75	7.55
18	1624	15	6.55	67.9	0.033	8.01	8.32	0.025	3.65	7.50

(Sheet 3 of 3)

Table I9
Date: 04 August 92 - Mobil Oil - Clamshell Dredge (Closed Bucket)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0923	3	1.26	67.5	0.035	8.04	18.1	3.12	3.63	8.10
13	0923	10	4.36	67.0	0.034	8.05	10.8	0.032	3.90	8.12
13	0923	15	6.52	66.7	0.033	8.04	8.41	0.015	4.08	8.09
14	0932	3	1.36	67.3	0.035	8.07	15.7	4.57	3.68	7.97
14	0932	9	3.92	67.2	0.034	8.08	11.8	0.053	3.91	7.97
14	0932	14	6.02	66.9	0.033	8.09	10.0	0.017	4.08	8.05
11	1004	2	0.863	67.5	0.036	8.03	18.7	18.3	3.49	7.89
11	1004	9	3.84	67.4	0.035	8.03	18.4	0.109	3.57	7.87
11	1004	15	6.52	67.2	0.034	8.05	12.5	0.018	3.75	7.93
16	0849	3	1.28	67.9	0.035	7.68	12.3	1.21	3.48	7.78
16	0849	10	4.26	67.9	0.035	7.74	8.32	0.027	3.66	7.92
17	0903	3	1.34	67.9	0.035	7.99	11.8	1.53	3.47	8.00
17	0903	10	4.39	67.7	0.035	8.02	20.8	0.030	3.36	8.08
17	0903	15	6.44	67.6	0.035	8.02	18.4	0.017	3.43	8.21
18	0911	3	1.39	68.0	0.035	8.04	17.9	1.55	3.49	7.91

(Sheet 1 of 3)

Table I9 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
18	0911	10	4.36	67.7	0.035	8.06	19.6	0.032	3.39	7.98
18	0911	15	6.44	67.7	0.035	8.07	19.2	0.017	3.39	8.04
11	1249	2	0.863	63.9	0.027	7.93	1.88	6.26	6.90	9.04
11	1249	9	3.92	63.9	0.027	7.92	1.86	0.019	7.03	9.02
11	1249	15	6.44	63.8	0.026	7.94	0.61	0.013	7.54	8.96
13	1552	3	1.26	63.7	0.025	7.97	0.00	0.034	9.28	9.40
13	1552	11	4.73	63.0	0.018	8.04	-0.05	0.014	10.0	9.49
13	1552	17	7.28	62.9	0.018	8.05	-0.02	0.014	10.0	9.52
14	1606	3	1.31	63.5	0.025	8.02	-0.02	0.036	10.0	8.72
14	1606	10	4.28	62.9	0.019	8.05	-0.02	0.015	10.0	9.05
14	1606	15	6.57	62.7	0.016	8.09	-0.05	0.014	10.0	9.28
11	1523	2	0.811	63.6	0.024	8.02	-0.02	0.347	8.74	9.34
11	1523	9	3.94	63.5	0.023	8.01	-0.05	0.015	9.73	9.44
11	1523	15	6.47	63.4	0.023	8.02	-0.02	0.013	10.0	9.34
16	1626	10	4.36	63.4	0.021	7.97	-0.05	0.015	10.0	9.19
16	1626	15	6.94	63.4	0.021	7.98	-0.02	0.014	10.0	9.13

(Sheet 2 of 3)

Table I9 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
17	1651	3	1.31	63.4	0.020	7.96	-0.02	0.037	10.0	9.06
17	1651	10	4.31	63.3	0.020	7.95	-0.05	0.014	10.0	9.01
18	1713	3	1.28	63.4	0.020	7.96	-0.05	0.033	10.0	9.25
18	1713	9	3.94	63.4	0.020	7.95	-0.05	0.015	10.0	9.30
18	1713	14	6.07	63.4	0.020	7.96	-0.05	0.014	10.0	9.18

(Sheet 3 of 3)

Table I10
Date: 05 August 92 - Mobil Oil - Background Samples

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	1024	3	1.26	61.3	0.019	7.85	0.27	0.686	6.35	9.72
13	1024	10	4.31	61.0	0.019	7.85	0.25	0.014	6.53	9.67
13	1024	15	6.55	60.7	0.018	7.88	0.25	0.011	6.60	9.69
14	1033	3	1.31	60.9	0.019	7.88	0.17	0.343	6.65	8.86
14	1033	6	2.68	60.9	0.019	7.88	0.25	0.022	6.63	9.33
14	1033	9	3.86	60.7	0.018	7.89	0.32	0.014	6.61	9.38
16	0930	3	1.23	61.2	0.018	7.02	0.15	0.540	6.20	9.60
16	0930	10	4.34	61.0	0.018	7.09	0.08	0.015	6.55	9.59
16	0930	15	6.55	61.0	0.018	7.15	0.08	0.013	6.72	9.64
17	0955	3	1.26	61.1	0.018	7.54	0.05	0.422	6.56	9.34
17	0955	10	4.36	61.0	0.018	7.60	0.15	0.014	6.67	9.37
17	0955	15	6.52	61.0	0.018	7.62	0.10	0.013	6.80	9.44
18	1011	3	1.36	61.1	0.018	7.74	0.15	0.414	6.70	8.98
18	1011	10	4.34	61.0	0.018	7.76	0.15	0.015	6.91	9.47
18	1011	15	6.47	61.0	0.018	7.79	0.10	0.012	7.00	9.38

Table I11
Date: 06 August 92 - Mobil Oil - Toyo Pump

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0808	3	1.26	64.0	0.026	7.82	16.2	37.2	3.61	8.30
13	0808	10	4.31	63.9	0.026	7.84	15.8	0.142	3.80	8.87
13	0808	15	6.44	63.8	0.025	7.87	17.3	0.022	3.78	8.90
14	0817	3	1.36	63.6	0.025	7.86	14.4	16.5	3.95	8.59
14	0817	9	3.94	63.5	0.025	7.88	16.9	0.202	3.69	8.85
14	0817	14	6.02	63.6	0.025	7.90	14.8	0.026	3.65	8.93
15	0820	3	1.28	63.6	0.025	7.88	14.3	41.3	3.95	8.28
15	0820	4	1.73	63.5	0.025	7.89	15.3	15.6	3.91	8.30
15	0820	7	3.07	63.5	0.025	7.90	17.4	1.13	3.79	8.37
11	0937	2	0.968	64.8	0.026	7.93	16.2	195.8	2.97	8.28
11	0937	9	3.92	64.3	0.026	7.94	10.6	0.338	3.57	8.93
11	0937	15	6.52	64.2	0.026	7.94	4.11	0.022	4.05	8.76
16	0735	3	1.26	66.5	0.025	7.48	13.7	21.9	3.60	7.86
16	0735	10	4.31	65.3	0.026	7.55	12.8	0.069	3.85	8.61

(Sheet 1 of 3)

Table I11 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
16	0735	15	6.47	65.2	0.026	7.59	9.07	0.021	4.00	8.51
17	0745	3	1.26	66.0	0.025	7.78	14.1	32.0	3.50	8.56
17	0745	10	4.39	65.1	0.025	7.82	11.7	0.066	3.85	8.70
17	0745	15	6.55	65.1	0.025	7.84	9.95	0.019	3.99	8.75
18	0753	3	1.39	65.8	0.025	7.86	14.6	29.4	3.36	7.51
18	0753	10	4.36	65.1	0.025	7.88	8.93	0.088	3.89	8.17
18	0753	15	6.52	65.1	0.025	7.89	6.09	0.019	4.19	8.53
11	1246	2	0.863	67.8	0.026	7.89	15.4	281.5	3.06	9.05
11	1246	9	3.89	64.2	0.026	7.91	14.0	1.11	3.36	9.13
11	1246	15	6.42	63.4	0.026	7.93	9.64	0.037	3.57	9.38
13	1620	3	1.26	65.2	0.027	7.98	25.0	169.2	3.11	9.71
13	1620	10	4.39	63.0	0.027	7.99	20.3	1.53	3.20	9.99
13	1620	15	6.44	62.8	0.027	8.02	22.0	0.095	3.07	9.79
14	1626	3	1.26	65.0	0.029	7.92	22.4	187.2	3.34	9.70
14	1626	9	3.84	63.5	0.028	7.94	19.7	2.49	3.37	9.66
14	1626	14	6.07	62.8	0.027	7.96	21.5	0.107	3.18	9.69

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Table I11 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
15	1629	3	1.31	64.8	0.029	7.93	22.6	183.7	3.29	9.90
15	1629	4	1.78	64.1	0.029	7.93	21.2	78.3	3.30	9.90
15	1629	7	3.07	63.8	0.028	7.93	19.6	8.45	3.37	9.76
11	1600	2	0.916	68.7	0.028	7.97	12.6	336.9	3.22	9.04
11	1600	9	3.89	63.9	0.027	7.97	11.1	0.544	3.52	9.55
11	1600	15	6.55	62.6	0.026	7.98	5.72	0.029	3.59	9.55
16	1653	3	1.31	67.8	0.027	7.97	9.59	48.5	3.60	8.65
16	1653	10	4.42	63.4	0.027	7.97	11.7	0.080	3.67	9.12
16	1653	15	6.52	62.7	0.026	7.98	6.53	0.026	3.59	9.01
17	1707	3	1.28	68.1	0.027	7.97	11.2	84.4	3.48	8.71
17	1707	10	4.39	64.1	0.028	7.96	15.9	0.125	3.57	9.10
17	1707	15	6.47	63.1	0.027	7.98	4.06	0.028	3.48	9.20
18	1720	3	1.28	67.9	0.027	7.95	9.24	70.2	3.32	8.58
18	1720	15	6.52	63.0	0.027	7.96	5.99	0.029	3.54	9.32
18	1720	10	4.31	64.1	0.028	7.95	15.2	0.133	3.49	9.33

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Table I12
Date: 07 August 92 - Mobil Oil - Toyo Pump

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0814	3	1.28	70.3	0.033	8.32	25.2	94.0	2.65	7.91
13	0814	11	4.78	67.3	0.033	8.35	9.07	0.245	3.28	8.37
13	0814	16	6.92	66.4	0.032	8.23	7.73	0.023	3.63	8.33
14	0822	10	4.28	69.4	0.033	8.36	11.0	0.309	3.28	8.17
14	0822	3	1.34	70.2	0.033	8.34	21.9	63.7	2.80	8.02
14	0822	9	3.97	69.5	0.033	8.37	13.7	0.534	3.21	8.14
14	0822	14	6.05	66.7	0.032	8.32	4.82	0.032	3.73	8.55
11	0927	2	0.890	69.7	0.033	8.35	20.6	192.2	2.96	8.22
11	0927	9	3.97	68.0	0.032	8.31	11.1	0.300	3.29	8.43
11	0927	15	6.55	66.7	0.031	8.24	7.02	0.024	3.62	8.59
16	0740	3	1.34	69.5	0.032	7.85	22.6	23.5	2.90	8.50
16	0740	8	3.49	67.6	0.031	7.91	22.1	0.978	2.99	8.86
16	0740	14	6.02	66.0	0.030	7.91	10.2	0.050	3.25	9.15
17	0750	3	1.34	69.3	0.032	8.20	20.8	19.9	2.97	8.11
17	0750	15	6.44	65.9	0.030	8.15	9.95	0.029	3.38	8.99

(Sheet 1 of 3)

Table I12 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
18	0800	3	1.23	69.3	0.032	8.28	16.5	50.7	3.03	8.28
18	0800	10	4.36	68.2	0.032	8.25	15.4	0.216	3.13	8.42
18	0800	15	6.47	65.7	0.029	8.21	14.0	0.027	3.32	8.83
11	1049	2	0.890	70.1	0.033	8.41	24.5	246.0	2.84	8.07
11	1049	9	3.94	68.1	0.032	8.36	7.58	0.310	3.34	8.30
11	1049	15	6.55	66.3	0.030	8.29	7.22	0.022	3.56	8.46
11	1148	2	0.916	70.1	0.033	8.40	24.9	431.3	2.78	7.99
11	1148	9	3.86	67.8	0.032	8.35	3.50	0.569	3.36	8.22
11	1148	15	6.52	66.1	0.030	8.26	7.63	0.023	3.53	8.35
11	1358	2	0.837	69.5	0.034	8.33	26.2	436.1	2.97	7.67
11	1358	9	3.84	68.7	0.033	8.27	3.08	0.608	3.24	8.47
11	1358	15	6.44	66.6	0.031	8.23	0.71	0.026	3.88	8.24
13	1627	3	1.26	69.0	0.035	8.20	31.3	128.3	2.98	8.29
13	1627	10	4.36	67.2	0.032	8.20	35.0	3.34	2.58	8.25
13	1627	15	6.55	66.2	0.031	8.19	32.2	0.307	2.28	8.68
14	1636	3	1.68	68.6	0.035	8.18	33.3	149.6	2.85	8.42

(Sheet 2 of 3)

Table I12 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
14	1636	9	3.86	67.8	0.033	8.17	31.6	8.51	2.66	8.27
14	1636	14	6.10	66.3	0.032	8.17	30.5	0.524	2.46	8.44
11	1553	9	3.94	68.4	0.033	8.23	4.62	0.336	3.29	7.95
11	1553	15	6.49	67.8	0.032	8.17	2.96	0.026	3.39	7.64
16	1700	3	1.21	70.9	0.034	8.30	19.6	66.4	3.14	8.21
16	1700	9	3.97	68.2	0.033	8.27	7.78	0.422	3.15	8.24
16	1700	14	6.02	66.9	0.031	8.19	2.15	0.035	3.43	7.85
17	1725	3	1.31	70.0	0.034	8.27	19.4	62.8	2.94	6.20
17	1725	10	4.36	67.9	0.033	8.22	10.9	0.255	3.10	7.79
17	1725	15	6.44	66.2	0.031	8.16	0.98	0.033	3.60	8.21
18	1733	3	1.34	69.7	0.034	8.26	20.2	73.7	2.78	8.35
18	1733	9	3.94	68.2	0.033	8.22	9.95	0.599	3.00	8.10
18	1733	14	6.05	66.7	0.031	8.16	0.88	0.036	3.55	7.98

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Table I13
Date: 08 August 92 - Dead Man's Creek - Toyo Pump

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
13	0830	3	1.36	67.4	0.026	7.75	24.0	3.42	3.89	7.73
13	0830	13	5.71	67.3	0.026	7.77	23.0	0.027	3.85	7.73
13	0830	20	8.71	65.5	0.023	7.81	13.9	0.019	3.98	8.03
14	0843	3	1.36	67.4	0.027	7.83	23.6	11.5	3.95	7.52
14	0843	14	6.07	67.1	0.026	7.84	21.5	0.034	3.84	7.77
14	0843	21	9.15	65.8	0.024	7.86	11.2	0.023	3.96	7.75
15	0852	18	7.84	66.6	0.025	7.88	22.7	0.023	3.83	7.86
15	0852	3	1.34	67.4	0.027	7.83	23.5	11.9	4.01	7.74
15	0852	20	8.65	66.3	0.025	7.88	20.8	0.023	3.81	7.88
11	1011	3	1.34	67.3	0.024	7.54	32.7	8.57	4.32	5.74
11	1011	13	5.60	66.8	0.024	7.57	30.3	0.042	4.05	7.65
11	1011	21	9.18	65.6	0.023	7.61	25.2	0.023	4.00	7.64
16	0748	3	1.26	67.7	0.023	6.98	30.8	2.28	3.58	7.84
16	0748	19	8.29	65.8	0.023	7.15	16.5	0.017	3.97	7.88

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Table I13 (Continued)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
17	0800	3	1.31	67.7	0.023	7.49	29.0	5.85	3.83	7.16
17	0800	14	6.02	66.9	0.023	7.54	19.9	0.028	4.14	7.75
17	0800	21	9.18	65.5	0.022	7.58	19.1	0.016	4.10	7.81
18	0814	14	6.10	67.1	0.023	7.63	24.1	0.039	3.91	7.60
18	0814	21	9.18	65.5	0.022	7.66	17.9	0.018	4.10	7.71
11	1318	3	1.21	67.0	0.024	7.34	29.7	26.2	4.05	7.24
11	1318	21	9.05	66.6	0.024	7.46	25.5	0.017	4.06	7.73
11	1318	25	10.8	66.6	0.024	7.48	24.9	0.017	4.02	7.70
13	1617	3	1.36	67.9	0.027	7.88	28.3	39.8	4.48	8.05
13	1617	14	5.99	67.4	0.027	7.88	26.9	0.053	4.25	8.08
13	1617	20	8.68	67.2	0.027	7.90	26.6	0.022	4.14	7.90
14	1625	3	1.28	67.8	0.027	7.88	27.6	54.5	4.39	6.69
14	1625	14	6.15	67.5	0.027	7.90	26.7	0.060	4.23	7.76
14	1625	21	9.08	67.3	0.027	7.90	26.6	0.023	4.03	7.82
15	1634	3	1.26	67.7	0.027	7.87	27.1	96.2	4.18	7.78
15	1634	13	5.63	67.6	0.027	7.89	26.3	0.096	4.14	7.89

(Sheet 2 of 3)

Table I13 (Concluded)

Station Number	Time	Sample Depth, ft	Pressure, psi	Temperature, deg F	Conductivity, S/m	pH	% Light Transmission	Irradiance, PAR	Fluorescence	Dissolved Oxygen, mg/ℓ
11	1549	3	1.28	67.2	0.025	7.76	30.5	63.7	3.98	6.84
11	1549	13	5.65	67.0	0.025	7.76	20.3	0.054	3.93	8.12
11	1549	21	9.10	66.8	0.025	7.78	16.6	0.019	3.96	7.92
16	1655	3	1.26	67.3	0.025	7.79	29.9	89.9	3.86	6.71
16	1655	13	5.63	67.0	0.025	7.79	27.9	0.073	3.81	7.32
16	1655	20	8.63	66.9	0.024	7.80	27.2	0.025	3.83	7.55
17	1714	3	1.23	67.3	0.025	7.81	30.1	5.83	3.99	7.28
17	1714	14	6.10	67.0	0.025	7.82	28.8	0.033	3.90	7.59
17	1714	21	9.15	66.9	0.024	7.84	24.9	0.027	3.85	7.54
18	1723	3	1.23	67.4	0.025	7.80	31.7	7.14	4.02	5.40
18	1723	14	6.02	67.2	0.025	7.81	29.7	0.038	3.98	7.70
18	1723	21	9.13	66.9	0.024	7.82	28.4	0.028	3.88	7.56

(Sheet 3 of 3)

Appendix J
Dredging Elutriate Test (DRET) - Physical and Chemical Data Summary Statistics[1]

[1] References cited in this appendix are located at the end of the main text.

Table J1
Dredging Elutriate Test - Total Physical and Chemical Data[1]
B/L Station Pre-Dredge Sediment Sample 554+60

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
Total suspended solids, mg/ℓ	3	190.3	151.0	237.0	43.5	1,889.3	25.1
pH, mg/ℓ	3	7.7	7.6	7.8	0.1	0.0	0.1
Total organic carbon, mg/ℓ	3	8.8	8.0	9.5	0.8	0.6	0.4
Conductivity, μmhos/cm	3	390	390	390	0	0	0
Nitrogen ammonia, mg/ℓ	3	1.5	1.5	1.6	0.1	0.0	0.0
Phenanthrene, mg/ℓ	3	0.0080	0.0070	0.0090			
Pyrene, mg/ℓ	3	0.0052	0.0000	0.0081			
Fluoranthene, mg/ℓ	3	0.0043	0.0000	0.0130			
B.(a)anthracene, mg/ℓ	3	0.0010	0.0005	0.0018			
B.(k)fluoranthene, mg/ℓ	3	0.0001	0.0000	0.0002			
B.(a)pyrene, mg/ℓ	3	0.0002	0.0000	0.0007			
Chromium, mg/ℓ	3	0.104	0.081	0.120	0.020	0.000	0.012
Copper, mg/ℓ	3	0.108	0.084	0.120	0.021	0.000	0.012
Lead, mg/ℓ	3	0.103	0.092	0.120	0.015	0.000	0.009
Zinc, mg/ℓ	3	0.453	0.390	0.490	0.055	0.003	0.032

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors and unlisted PAH compounds were below detection.

Table J2
Dredging Elutriate Test - Filtered Physical and Chemical Data[1]
B/L Station Pre-Dredge Sediment Sample 554+60

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
pH, mg/ℓ	3	8.0	7.9	8.0	0.1	0.0	0.0
Total organic carbon, mg/ℓ	3	7.3	7.1	7.5	0.2	0.0	0.1
Conductivity, μmhos/cm	3	347	340	360	12	133	7
Nitrogen ammonia, mg/ℓ	3	1.3	1.2	1.4	0.1	0.0	0.1
Dib.(a,h)anthracene, mg/ℓ	3	0.11	0.00	0.33			
Chromium, mg/ℓ	3	0.000	0.000	0.000	0.000	0.000	0.000
Copper, mg/ℓ	3	0.000	0.000	0.000	0.000	0.000	0.000
Lead, mg/ℓ	3	0.006	0.003	0.010	0.004	0.000	0.002
Zinc, mg/ℓ	3	0.063	0.050	0.086	0.020	0.000	0.011

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors and unlisted PAH compounds and metals were below detection.

Table J3
Dredging Elutriate Test - Total Physical and Chemical Data[1]
B/L Station Pre-Dredge Sediment Sample 776+80

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
Total suspended solids, mg/ℓ	3	508.0	95.0	13,330.0	711.8	506,726.1	411.0
pH, mg/ℓ	3	8.0	7.9	8.0	0.1	0.0	0.0
Total organic carbon, mg/ℓ	3	7.9	7.6	8.3	0.4	0.1	0.2
Conductivity, μmhos/cm	3	410	400	430	17	300	10
Nitrogen ammonia, mg/ℓ	3	2.4	2.1	2.7	0.3	0.1	0.2
B.(b)fluoranthene, mg/ℓ	3	0.0001	0.0000	0.0004			
Chromium, mg/ℓ	3	0.006	0.000	0.009	0.005	0.000	0.003
Copper, mg/ℓ	3	0.003	0.000	0.010	0.006	0.000	0.003
Lead, mg/ℓ	3	0.019	0.016	0.021	0.003	0.000	0.001
Zinc, mg/ℓ	3	0.099	0.087	0.120	0.018	0.000	0.010

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors and unlisted PAH compounds were below detection.

Table J4
Dredging Elutriate Test - Filtered Physical and Chemical Data[1]
B/L Station Pre-Dredge Sediment Sample 776+80

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
pH, mg/ℓ	3	7.8	7.8	7.9	0.1	0.0	0.0
Total organic carbon, mg/ℓ	3	7.3	7.1	7.8	0.4	0.2	0.2
Conductivity, μmhos/cm	3	327	320	330	6	33	3
Nitrogen ammonia, mg/ℓ	3	1.9	1.8	2.0	0.1	0.0	0.1
Chromium, mg/ℓ	3	0.000	0.000	0.000	0.000	0.000	0.000
Copper, mg/ℓ	3	0.000	0.000	0.000	0.000	0.000	0.000
Lead, mg/ℓ	3	0.002	0.002	0.003	0.001	0.000	0.000
Zinc, mg/ℓ	3	0.066	0.048	0.082	0.017	0.000	0.010

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors and unlisted PAH compounds were below detection.

Table J5
Dredging Elutriate Test - Total Physical and Chemical Data[1]
B/L Station Pre-Dredge Sediment Sample 562+80

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
Total suspended solids, mg/ℓ	3	119.1	62.9	195.0	68.2	4,651.7	39.4
pH, mg/ℓ	3	7.8	7.7	7.9	0.1	0.0	0.1
Total organic carbon, mg/ℓ	3	8.9	7.9	10.0	1.1	1.1	0.6
Conductivity, µmhos/cm	3	423	420	430	6	33	3
Nitrogen ammonia, mg/ℓ	3	1.9	1.5	2.4	0.5	0.2	0.3
B.(a)anthracene, mg/ℓ	3	0.0005	0.0002	0.0007			
Chromium, mg/ℓ	3	0.088	0.045	0.170	0.071	0.005	0.041
Copper, mg/ℓ	3	0.086	0.044	0.160	0.064	0.004	0.037
Lead, mg/ℓ	3	0.107	0.055	0.180	0.065	0.004	0.038
Zinc, mg/ℓ	3	0.363	0.220	0.640	0.240	0.057	0.138

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors and unlisted PAH compounds were below detection.

Table J6
Dredging Elutriate Test - Filtered Physical and Chemical Data[1]
B/L Station Pre-Dredge Sediment Sample 562+80

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
pH, mg/ℓ	3	7.9	7.8	7.9	0.1	0.0	0.0
Total organic carbon, mg/ℓ	3	7.2	7.2	7.3	0.1	0.0	0.0
Conductivity, µmhos/cm	3	333	320	340	12	133	7
Nitrogen ammonia, mg/ℓ	3	1.8	1.6	2.0	0.2	0.0	0.1
Chromium, mg/ℓ	3	0.000	0.000	0.000	0.000	0.000	0.000
Copper, mg/ℓ	3	0.000	0.000	0.000	0.000	0.000	0.000
Lead, mg/ℓ	3	0.004	0.004	0.004	0.000	0.000	0.000
Zinc, mg/ℓ	3	0.085	0.072	0.092	0.011	0.000	0.007

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors and unlisted PAH compounds were below detection.

Appendix K
Summary Statistics for Post-Dredged Sediment[1]

[1] References cited in this appendix are located at the end of the main text.

Table K1
Post-Dredge Sediment Physical and Chemical Conditions[1] - B/L Stations 552+00 to 555+00

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
Total solids, %	5	56.0	51.5	63.4	5.6	31.1	2.5
pH, mg/kg	5	6.4	6.2	6.8	0.2	0.0	0.1
TOC, mg/kg	5	19,180	14,500	24,800	4,118	1.7×10^7	1,842
Napthalene[2]	5	0.000	0.000	0.000	0.000	0.000	0.000
Acenaphthylene	5	0.000	0.000	0.000	0.000	0.000	0.000
Acenapthene	5	0.552	0.000	1.400	0.584	0.341	0.261
Fluorene	5	0.150	0.000	0.750	0.335	0.113	0.150
Phenanthrene	5	2.090	0.650	4.600	1.643	2.701	0.735
Anthracene	5	0.674	0.000	1.600	0.587	0.344	0.262
Fluoranthene	5	0.920	0.000	3.300	1.445	2.087	0.646
Pyrene	5	3.460	1.100	6.500	2.103	4.423	0.941
Chrysene	5	0.456	0.000	1.000	0.466	0.217	0.208
B.(a)Anthracene	5	0.638	0.260	2.000	0.711	0.506	0.318
B.(b)Fluoranthene	5	0.524	0.270	1.100	0.335	0.112	0.150
B.(k)Fluoranthene	5	0.276	0.170	0.560	0.161	0.026	0.072
B.(a)pyrene	5	0.572	0.290	1.200	0.368	0.135	0.164
Dib.(a,h)anthracene	5	1.380	0.270	4.300	1.654	2.735	0.740

(Continued)

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors were below detection.
[2] All PAH and metals are given in mg/kg or ppm.

Table K1 (Concluded)

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
B.(g,h,i)perylene	5	0.460	0.000	1.600	0.706	0.498	0.316
I.(1,2,3-cd)pyrene	5	0.398	0.000	1.100	0.453	0.206	0.203
Arsenic[2]	5	10.9	3.9	16.0	4.6	21.6	2.1
Barium	5	87.0	64.7	98.1	13.1	172.4	5.9
Cadmium	5	2.8	2.0	3.9	0.8	0.6	0.3
Chromium	5	72.1	46.8	92.9	18.5	341.4	8.3
Copper	5	88.9	65.7	107.0	15.5	241.4	6.9
Iron	5	29,500	19,900	37,200	6,447	4.2×10^7	2,883
Lead	5	133.2	102.0	150.0	18.3	334.7	8.2
Manganese	5	397	284	497	92	8,392	41
Mercury	5	1.39	0.53	1.80	0.50	0.25	0.23
Nickel	5	32.5	24.1	41.6	6.5	42.0	2.9
Selenium	5	0.00	0.00	0.00	0.00	0.00	0.00
Silver	5	0.00	0.00	0.00	0.00	0.00	0.00
Sodium	5	1,608	1,150	1,950	321	102,870	143
Zinc	5	345	243	478	89	7,922	40

Table K2
Post-Dredge Sediment Physical and Chemical Conditions[1] - B/L Stations 775+00 to 779+60

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
Total solids, %	7	42.9	36.9	50.2	4.7	22.2	1.8
pH, mg/kg	7	7.3	7.0	7.6	0.2	0.0	0.1
TOC, mg/kg	7	17,143	13,700	19,800	2,231	5.0×10^6	843
Napthalene[2]	7	0.000	0.000	0.000	0.000	0.000	0.000
Acenaphthylene	7	0.000	0.000	0.000	0.000	0.000	0.000
Acenapthene	7	0.117	0.000	0.820	0.310	0.096	0.117
Fluorene	7	0.000	0.0000	0.000	0.000	0.000	0.000
Phenanthrene	7	0.286	0.000	0.760	0.303	0.092	0.115
Anthracene	7	0.066	0.000	0.230	0.090	0.008	0.034
Fluoranthene	7	0.501	0.000	1.600	0.647	0.419	0.245
Pyrene	7	0.983	0.000	3.600	1.302	1.695	0.492
Chrysene	7	0.187	0.000	0.580	0.207	0.043	0.078
B.(a)Anthracene	7	1.706	0.000	8.300	3.117	9.713	1.178
B.(b)Fluoranthene	7	0.220	0.000	0.560	0.231	0.053	0.087
B.(k)Fluoranthene	7	0.101	0.000	0.260	0.110	0.012	0.042
B.(a)pyrene	7	0.364	0.000	1.100	0.416	0.173	0.157
Dib.(a,h)anthracene	7	0.273	0.000	1.000	0.399	0.159	0.151

(Continued)

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors were below detection.
[2] All PAH and metals are given in mg/kg or ppm.

Table K2 (Concluded)

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
B.(g,h,i)perylene	7	0.247	0.000	0.700	0.271	0.073	0.102
I.(1,2,3-cd)pyrene	7	0.226	0.000	0.590	0.235	0.055	0.089
Arsenic[2]	7	10.9	6.4	17.2	3.7	13.7	1.4
Barium	7	106.3	83.7	143.0	22.2	494.7	8.4
Cadmium	7	1.5	1.0	2.3	0.5	0.2	0.2
Chromium	7	19.5	15.2	25.9	4.2	17.5	1.6
Copper	7	45.3	37.8	58.0	8.5	71.5	3.2
Iron	7	13,237	9,960	17,400	2,501	6.3×10^6	945
Lead	7	39.9	34.6	49.8	5.1	25.9	1.9
Manganese	7	690	568	813	98	9,546	37
Mercury	7	0.72	0.00	4.10	1.49	2.23	0.56
Nickel	7	27.1	22.6	33.0	4.5	20.2	1.7
Selenium	7	0.49	0.00	0.94	0.37	0.14	0.14
Silver	7	0.0	0.0	0.0	0.0	0.0	0.0
Sodium	7	0	0	0	0	0	0
Zinc	7	158	131	196	23	516	9

Table K3
Post-Dredge Sediment Physical and Chemical Conditions[1] - B/L Stations 779+60 to 781+40

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
Total solids, %	4	48.2	46.8	49.3	1.3	1.6	0.6
pH, mg/kg	4	7.4	7.1	7.7	0.3	0.1	0.1
TOC, mg/kg	4	14,925	13,300	15,800	1,112	1.2×10^6	556
Napthalene[2]	4	0.000	0.000	0.000	0.000	0.000	0.000
Acenaphthylene	4	0.143	0.000	0.300	0.165	0.027	0.083
Acenapthene	4	0.430	0.000	0.750	0.344	0.118	0.172
Fluorene	4	0.014	0.000	0.057	0.027	0.001	0.014
Phenanthrene	4	0.468	0.300	0.540	0.113	0.013	0.056
Anthracene	4	0.137	0.086	0.190	0.051	0.003	0.026
Fluoranthene	4	1.123	0.640	1.800	0.507	0.257	0.254
Pyrene	4	0.760	0.000	2.200	1.038	1.078	0.519
Chrysene	4	0.468	0.150	1.100	0.443	0.197	0.222
B.(a)Anthracene	4	4.515	0.089	11.000	5.188	26.920	2.594
B.(b)Fluoranthene	4	0.490	0.260	0.820	0.243	0.059	0.121
B.(k)Fluoranthene	4	0.355	0.260	0.460	0.105	0.011	0.052
B.(a)pyrene	4	0.725	0.560	0.850	0.129	0.017	0.064
Dib.(a,h)anthracene	4	0.548	0.000	1.100	0.482	0.232	0.241

(Continued)

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors were below detection.
[2] All PAH and metals are given in mg/kg or ppm.

Table K3 (Concluded)

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
B.(g,h,i)perylene	4	0.560	0.210	1.000	0.330	0.109	0.165
I.(1,2,3-cd)pyrene	4	1.208	0.230	3.800	1.730	2.994	0.865
Arsenic[2]	4	8.0	6.2	9.3	1.5	2.3	0.8
Barium	4	86.9	80.8	90.4	4.2	18.0	2.1
Cadmium	4	1.1	1.0	1.4	0.2	0.0	0.1
Chromium	4	19.1	16.0	22.1	3.1	9.4	1.5
Copper	4	42.6	33.5	52.5	8.5	73.0	4.3
Iron	4	11,800	11,400	12,400	490	2.4×10^5	245
Lead	4	51.3	35.9	80.2	19.7	388.7	9.9
Manganese	4	585	549	676	61	3,717	30
Mercury	4	0.21	0.00	0.35	0.17	0.03	0.08
Nickel	4	24.7	21.0	27.4	2.8	7.7	1.4
Selenium	4	0.15	0.00	0.59	0.30	0.09	0.15
Silver	4	0.0	0.0	0.0	0.0	0.0	0.0
Sodium	4	0	0	0	0	0	0
Zinc	4	153	140	165	13	158	6

Table K4
Post-Dredge Sediment Physical and Chemical Conditions[1] - B/L Stations 562+80 to 561+30

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
Total solids, %	5	49.1	44.3	53.4	3.9	15.0	1.7
pH, mg/kg	5	6.7	6.6	6.8	0.1	0.0	0.0
TOC, mg/kg	5	12,800	11,400	13,800	1,042	1.1×10^6	466
Napthalene[2]	5	0.000	0.000	0.000	0.000	0.000	0.000
Acenaphthylene	5	0.000	0.000	0.000	0.000	0.000	0.000
Acenapthene	5	0.280	0.000	1.400	0.626	0.392	0.280
Fluorene	5	0.058	0.000	0.290	0.130	0.017	0.058
Phenanthrene	5	0.360	0.042	0.830	0.329	0.108	0.147
Anthracene	5	0.000	0.000	0,000	0.000	0.000	0.000
Fluoranthene	5	0.316	0.000	0.650	0.323	0.104	0.144
Pyrene	5	0.342	0.000	1.000	0.479	0.230	0.214
Chrysene	5	0.170	0.000	0.730	0.315	0.099	0.141
B.(a)Anthracene	5	0.302	0.000	0.980	0.406	0.165	0.182
B.(b)Fluoranthene	5	0.394	0.200	0.770	0.233	0.054	0.104
B.(k)Fluoranthene	5	0.177	0.023	0.750	0.321	0.103	0.143
B.(a)pyrene	5	0.523	0.035	0.880	0.340	0.116	0.152
Dib.(a,h)anthracene	5	0.306	0.120	0.610	0.224	0.050	0.100

(Continued)

[1] Summary statistics were calculated by assuming below-detection values were zero (NYDEC 1989). All PCB Aroclors were below detection.
[2] All PAH and metals are given in mg/kg or ppm.

Table K4 (Concluded)

Parameter	No. of Samples	Mean	Minimum Value	Maximum Value	Standard Deviation	Variance	Standard Error
B.(g,h,i)perylene	5	0.194	0.000	0.740	0.321	0.103	0.144
I.(1,2,3-cd)pyrene	5	0.296	0.100	0.560	0.203	0.041	0.091
Arsenic[2]	5	11.2	9.2	14.0	2.1	4.6	1.0
Barium	5	104.7	88.5	113.0	10.1	101.2	4.5
Cadmium	5	0.0	0.0	0.0	0.0	0.0	0.0
Chromium	5	26.1	20.4	29.3	3.4	11.8	1.5
Copper	5	45.8	38.0	52.0	5.2	27.1	2.3
Iron	5	32,240	27,200	35,500	3,115	9.7×10^6	1,393
Lead	5	54.4	35.4	84.4	18.5	341.6	8.3
Manganese	5	592	496	661	62	3,849	28
Mercury	5	0.18	0.00	0.31	0.12	0.01	0.05
Nickel	5	34.8	31.3	38.3	2.7	7.5	1.2
Selenium	5	1.20	0.00	2.70	1.35	1.83	0.61
Silver	5	0.0	0.0	0.0	0.0	0.0	0.0
Sodium	5	974	733	1,240	226	50,999	101
Zinc	5	188	147	218	28	767	12

Appendix L
Side-Scan Sonar Interpretation for the Buffalo River Dredging Demonstration

Sound has been proven a valuable tool for studying underwater features and is particularly useful for mapping the river bottom over a large range of spatial scales. Depending on the size of feature on the river bottom to be imaged, various acoustical equipment can be employed to achieve the required resolution (or the minimum horizontal distance between adjacent features for each feature to be imaged). For the purposes of this study, a short-range side-scan sonar was used, which can resolve river bottom features less than 1 m in amplitude and having a horizontal separation of a few meters or less.

Like all sonar systems, a side-scan sonar uses returned acoustic energy to form an image of the topography of the bottom. A side-scan sonar transmits a fan-shaped sound beam to either side of the sonar fish instead of directing it downward, as is the case of conventional echo sounders. Therefore, side-scan sonar only images the surface of the river bottom and does not penetrate into the sediment. This sideways-oriented sound beam is narrow in the vertical direction and wide in the direction transverse to the fish track. The strength of the returned sound beam is affected by topography of the sediment surface as well as by differing lithologies and bottom surface roughness. Objects which extend above the bottom having slopes facing the fish will return stronger signals than those slopes which face away. Thus, one can utilize this geometry to determine the height of an obstacle off the bottom. Depressions in the bottom would only have a back wall, which would reflect energy back to the sonar fish with a shadow zone in front.

The rougher the river bottom is, the more energy it returns. Therefore, a qualitative measurement of percent sand to mud grain size can be determined by the strength of the return. A strong return is generally darker on the sonar record, while weaker returns or acoustic shadows are lighter or white. Side-scan sonar records are not plan views of the sediment surface; however, with application of simple algorithms they can be interpreted in terms of morphology of the river bottom.

A Klein dual-frequency (100-kHz and 500-kHz) side-scan sonar was used to survey the pre- and post-dredge demonstration sites. Utilizing a 37.5-m range scale, the swath width (total area covered) for the towed fish was 75 m along its towed path. The sonar was routinely positioned 4 m off the river bottom and several passes were made over the demonstration sites. Two dredge sites were chosen for the dredge demonstration project; Site I across from the Mobil Refinery Plant between river markers 774 and 772 on the left bank (looking downstream) and Site II near Great Lakes Paper between river markers 550 and 563 on the right bank (looking downstream). At Site I, an open bucket, closed bucket, and suction dredge were used. At Site II, two specific areas were dredged. An open bucket was used between river marker 552 and the beginning of Great Lakes Paper and a suction dredge was used between river markers 561 and 563.

From the side-scan records, it is easy to identify the dredged region along the riverbanks, the areal extent of the affected area, and subsequent changes to those dredged regions from comparing side-scan records taken 2 months after the demonstration. Specifically, for the dredge demonstration, the type of return produced by the bucket dredge was a shadow zone with reflection off the back wall of a square-shaped depression. Similarly, the suction dredge produced a return with a shadow zone and then a strong return from the back wall of the depression but circular in shape. When dragging the suction head across the bottom, a semi-linear line of circular depression was produced.

Side-Scan Sonar Interpretation

Site I (river markers 774 - 772)

Prior to the dredge demonstration, this site appeared to have high sedimentation rates as evidenced by the smoothed bottom topography, sediment tailings and few objects protruding above the river bottom. Sediment tailings are sedimentary depositional bed forms which form down current behind obstacles. As the flow is deviated around the obstacle, a low-flow region is generated allowing suspended sediment to be deposited. Usually sediment tailings form in regions having high sedimentation rates.

Sonar images taken 2 days after the dredge demonstration show two distinct patterns which can be directly related to the style of dredging done; the bucket dredge and suction dredge device. No differentiation could be made between an open bucket and a closed bucket dredge at this site. Clearly the bucket style of dredging is more disruptive to the river bottom than suction dredging. In the region of the bucket dredging, the sonar records image large volume gouges which are haphazardly positioned. Bucket dredging left individual holes in the bottom up to 1.5 m in depth. Where repeated casts where done, bucket dredging significantly increased the bottom depth by 4 m. Suction dredging was more contained within the test area and less disruptive to

the river bottom outside this area. Less material was removed using the suction dredge than with bucket dredging.

Returning to the site after 2 months, it was impossible to compare the dredged areas. Channel navigational dredging had occurred, and most of the dredge test site was altered or destroyed by the navigational dredging. Only small portions nearest the bank were preserved, and no conclusions could be drawn from these few places. It is interesting to note, however, that central navigational dredging itself was greatly subdued by sedimentation. The side-scan records delineated the edges of the navigation dredging area, which came to within 6 m of the left bank and 10 m of the right bank. The dynamics within this reach of the river are such that the bottom topography disrupted by the channel dredging was significantly smoothed and the large gouges were mostly filled in over the 2-month period. This implies that a high sedimentation rate occurs in this region which can quickly smooth out any bottom roughness generated by channel dredging.

Site II (Great Lakes Paper) 552 - 563

Open bucket dredging between Dead Man's Cove and Great Lakes Paper (552-GLP). Pre-dredging records show that this reach of the river appears to have a low sedimentation. This is evidenced by large debris located in the central channel area, which has been in a similar position within the river for the last 3 years (Fuller 1992; Manley, Fuller, and Singer 1992). The debris includes numerous large logs (up to 10 m long) and truck tires. These obstacles have little sediment tailing associated with them, indicating lower sediment accumulations. The river currents are sufficiently strong to align the large logs with their long axis parallel to the riverbanks (i.e., aligned with the river flow).

The bank region where the open bucket dredging occurred was of subtle relief, having little bottom debris and a gentle slope. The bucket dredging altered this slope by producing a bottom topography having multiple square-shaped depressions randomly arranged and the gentle slope has been steepened as material was removed to within 3 m of the bank edge. Long, thin, linear grooves are visible in the post-dredge sonar records. These were produced when the slit curtain moved downriver and dragged its anchors along the bottom.

In the post-dredge sonar images obtained 2 months later, these drag scars are still visible. Little change occurred to the bottom topography between the dredge and post-dredge surveys. Thus this area will slowly undergo change after any dredging and the altered bottom topography may remain for a significant period of time. However, this dredge site area had its bank slope greatly increased, thus creating the opportunity for rapid mass failure in the future as the riverbank tries to reestablish its slope equilibrium.

Suction (561-563). Pre-dredging records documented a predominant sedimentary bed form in the section to be dredged; a sediment ribbon or longitudinal sediment wave. Recognized as a long (180-m) linear ridge which parallels the shoreline, this type of sediment bed form is produced by a helical secondary circulation which moves the finer-grained sediment fraction into current-parallel rows, leaving coarser material between the rows. Several reaches of the Buffalo River containing sediment ribbons have been documented within the Area of Concern (AOC) and are usually located near the channel margins, where the highest percentages of coarser sized sediment are found. After suction dredging, the sonar records show the same characteristic pattern of linear, parallel rows of circular-shaped depressions. At this site, the suction dredging crossed the sediment ribbon bed form, disrupting its linear pattern. The post-dredging survey showed that the sediment ribbon had not been reestablished and that there had not been a significant movement of material to fill in and smooth the depression made from the suction dredging.

Appendix M Dredged Material Transportation Barge Supernatant Clarification

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Background

The U.S. Bureau of Mines (USBM) entered into a cooperative research effort with the U.S. Army Corps of Engineers, Buffalo District, for the purpose of testing the applicability of flocculation technology in cleanup activities associated with dredging contaminated river sediments. Over many years, pollution of the rivers has resulted in concentrated toxins being deposited in the river bottom sediments. Dredging is usually required for clean-up activities that require removal of the contaminated sediments.

The Buffalo River Environmental Dredging Demonstration tested one hydraulic dredge—the submersible pump. This dredging equipment generated

larger quantities of water than clamshell dredging. The transportation of this "excess" water by barge adds to the cost of sediment removal.

The USBM's contribution in this effort was the demonstration of low-cost methods to flocculate the particulates which would allow the "clean" water to be directly returned to its source, i.e., the river, reducing costs by eliminating the transportation, handling, and disposal of excess water. Also, techniques such as flocculation may result in higher percent solids of dredged material in the confined disposal facility (CDF) and could therefore increase the capacity of the CDF. The technology tested was pioneered by USBM in the dewatering research activities associated with mineral recovery, waste minimization, and waste utilization at mining operations (Sharma and Scheiner 1961).

Flocculation Technology

Dewatering of slurries has been successfully accomplished by the proper use of polymers in flocculating the fine particulate matter suspended in mineral processing streams. The adsorption of polymers on particulates is dependent upon the type, molecular weight, and concentration of functional groups associated with the polymer, as well as the surface charge, porosity, purity, and solution properties associated with the suspended particulates.

Three series of polymers (anionic, zero charge, and cationic) were lab tested on a sample of Buffalo River sediment obtained from the Corps. From these studies, a slightly anionic polymer (Photafloc 1110 manufactured by Neutron Products, Inc.) was selected for the field demonstration. This polymer sells for \$0.50 to \$0.75/lb depending upon the volume purchased. A 3.2-percent solution of this polymer was obtained from the manufacturer for the testing program described in this report.

Polymer Characteristics

Photafloc 1110 is an anionic copolymer of acrylamide and sodium acrylate with a molecular weight in excess of 10 million. It is a slightly basic, nonhazardous aqueous solution. The polymer solution contains a small amount (less than 0.02 percent) of unreacted acrylamide monomer, CAS 79-06-1, which has an Occupational Safety and Health Administration (OSHA) permissible exposure limit of 0.03 mg/m^3.

The American Council of Governmental Hygienists recommends a threshold value limit, 8-hr time-weighted average of 0.03 mg/m^3 for skin exposure. This acrylamide monomer level will not normally be reached when handling the solution. Also present is a small amount of sodium acrylate. The polymer is not listed as a carcinogen by the National Toxicological Program, nor is it regulated by OSHA. Also, it is not listed in Federal hazardous waste regulations (40 CFR 261.33, Paragraphs (e) and (f)), and does

not exhibit any of the hazardous characteristics listed in 40 CFR 261, Subpart C.

System Design

For this test, feed material from a barge was pumped through approximately 200 ft of 4-in. line to a 6-in. diesel centrifugal pump necked down to a 4-in. PVC pipeline delivery system. A 1,000-gal fiberglass tank was used to mix the polymer concentrate. The polymer was pumped through a 1-in. line using a variable-speed moyno type pump and introduced to the 4-in. feed line prior to passing through a 6-in. by 2-ft static mixer. The polymer/feed slurry traveled approximately 270 ft to the clarifying tank (approximately 1,700 gal at the overflow) where the flocculated material settled to the bottom, and allowed "clean" water to exit the overflow.

Results

A loaded barge from the hydraulic dredge demonstration site on the Buffalo River was delivered to the disposal site on August 6, 1992, with the flocculation studies beginning the following morning (Figure M1). In order to simulate an "on barge" system of treatment, the suction pump head at the unloading dock was lowered into the barge to "sweep" the settled sediments from the barge bottom. This was done to resuspend the settled material to represent the percent solids normally associated with the water in the barge during loading.

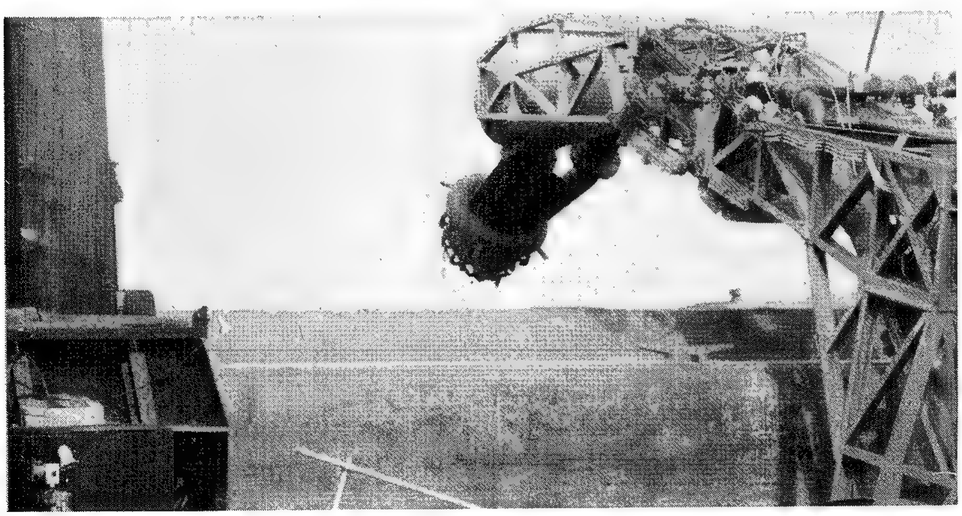

Figure M1. Submersible pump for mixing dredged material slurry and delivery to flocculation system

A series of three polymer concentrations was prepared during the study (0.02, 0.03, and 0.01 percent). This was accomplished by the addition of 5.04, 7.56, and 2.52 gal of 3.2 percent polymer to the polymer concentration tank. The polymer feed tank was then filled to the 807-gal level with lake water to yield the desired polymer concentrations. The flow rates of the feed material from the barge and the flow rates of the discharge from the polymer concentration tank were determined by timing the movement of the fluids in the tanks and calculating the volume used. Figure M2 shows the polymer concentrate tank and pump.

Figure M2. Small polymer pump on left beside concentrate tank, large diesel-powered pump on right

Tables M1 through M3 indicate the polymer flow rate, feed rate, and percent solids of the feed for each series of tests. Cost of treating 1,000 gal of feed is based upon a polymer cost of $0.50/lb. For each series, the polymer concentration was held constant and the dosage was changed at 10 min intervals by varying the flow rate of the polymer. Samples of the overflow were also collected for determination of the NTU values. Over 200 gpm of feed being pumped into the clarifying tank (Figure M3) created turbulent conditions which allowed some of the flocculated material to overflow with the clean water. For this reason, the overflow samples were allowed to settle for 8 min prior to making the NTU measurements.

The NTU values remained relatively constant for all 3 series of polymer concentrations except for Series 3, Test 5, where a significant increase in the NTU values occur. It is at this point where insufficient polymer is added to feed material to flocculate all of the suspended solids.

Table M1
Test Results for Series 1 Using the Following Conditions: Polymer Concentration of 0.02 Percent, Feed Rate of 241 gpm at 1.6 Percent Solids

Test Number	Polymer Dosage, gpm	Overflow, NTU	Cents per 1,000 Gal of Feed
1	19.87	17	8.23
2	19.90	15	7.01
3	11.51	13	4.78
4	7.06	17	2.93
5	3.96	13	1.64

Table M2
Test Results for Series 2 Using the Following Conditions: Polymer Concentration of 0.03 Percent, Feed Rate of 228 gpm at 1.5 Percent Solids

Test Number	Polymer Dosage, gpm	Overflow, NTU	Cents per 1,000 Gal of Feed
1	20.15	14	13.24
2	17.38	14	11.42
3	12.22	12	8.03
4	4.16	13	2.73
5	2.37	16	1.56

Table M3
Test Results for Series 3 Using the Following Conditions: Polymer Concentration of 0.01 Percent, Feed Rate of 219 gpm at 1.3 Percent Solids

Test Number	Polymer Dosage, gpm	Overflow, NTU	Cents per 1,000 Gal of Feed
1	20.43	12	4.66
2	17.91	12	4.08
3	12.11	13	2.76
4	6.96	15	1.59
5	2.27	27	0.52

Figure M3. Clarifying tank (2,000 gal) with feed line (top) and 6 to 4 in. underflow line (bottom left)

A sample of the flocculated material from the underflow was collected to determine the percent solids. The underflow solids were approximately 31 percent by weight for test 5 of the series shown in Table M3.

Bioassays

One of the major concerns for utilizing a polymer treatment system and discharging the "clean" water back into the Buffalo River is the effect the

polymer would have on organisms living in the river. From the data shown in Table M3, Test 5, approximately 2.27 gpm of 0.01 percent polymer was added to the 219-gpm feed material entering the tank clarifier. This is equivalent to approximately 1 ppm of polymer being added to the feed material from the barge.

Bioassays were conducted by the U.S. Army Engineer Waterways Experiment Station Environmental Laboratory in Vicksburg, MS. A sample of the feed (untreated water), and two samples of the clean water overflow (polymer treated) from the tank clarifier were collected for the purpose of conducting biological studies to determine if the polymer had any toxic response on living organisms (*Daphnia magna*). The *Daphnia magna* were tested in glass beakers containing 250 mℓ of each sample and survival rates were determined over time. Data from the different tests are shown in Tables M4 through M6.

Table M4
Survival of *Daphnia magna* (48-hr exposure)

Treatment Sample	Percent Survival			
	Test 1	Test 2	Test 3	Test 4
Feed	90	80	90	70
Overflow - 1	100	100	90	100
Overflow - 2	90	80	90	100

Table M5
Survival of *Daphnia magna* (96-hr exposure)

Treatment Sample	Percent Survival			
	Test 1	Test 2	Test 3	Test 4
Feed	20	10	10	0
Overflow - 1	60	50	40	50
Overflow - 2	50	60	50	40

Table M6
Duplicate Test of Survival of *Daphnia magna* (96-hr exposure)

Treatment Sample	Percent Survival			
	Test 1	Test 2	Test 3	Test 4
Feed	50	90	100	80
Overflow - 1	50	80	70	80
Overflow - 2	20	60	70	30

From Table M4, at the end of 48 hr, the *Daphnia magna* survival rate was higher in the treated water than the feed material. Table M5 data (96-hr survival rate) show similar results, with the survival rate in the feed diminishing to between 0 and 20 percent. Because of the higher indicated toxicity of the feed than the treated feed, another 96-hr survival rate test was conducted, with the results shown in Table M6. This second test seems to indicate higher survival rates in the feed and diminishing survival rates in the overflow samples.

The *Daphnia* did not thrive in any of these samples. However, because there are no clear cases where the data show greater toxicity of the treated water than that of the feed, these tests are inconclusive.

Concluding Remarks

Costs associated with the polymer requirements were calculated using $0.50/lb as the cost of the polymer. The NTU values remained relatively constant for all series of tests except the last test of Series III (test 5) with the NTU values increasing to 27. This most likely represents the transition point for complete flocculation of the particulate matter, with this NTU value still likely to be lower than the required regulatory level. This represents a polymer cost of approximately $0.0052 per 1,000 gal of feed or $5.20 for 1,000,000 gal.

The system demonstrated for this project was constructed on land for logistical purposes. Implementation of the system for barge overflow would require the polymer feed and mixing system to be mounted on a barge. Clarification would take place in a batch mode in the dredged material transportation barge or in a second barge standing by to receive and clarify flocculated supernatant.

Appendix N
Daphnia Magna Data

Table N1
Survival of *Daphnia magna* Exposed to Unfiltered Buffalo River Water - 96 Hr, 24-29 July

Date	Time	Station	SS[1]	pH	Percent Survival[2]					Mean
Controls				7.1	10+	10	9+	10	10+	9.8 ± 0.45
7/24	1300	13-15	78	6.1	8	9	10	9+	10+	9.2 ± 0.84
7/24	1600	16-18	367	6.4	10+	7+	7	10	10+	8.8 ± 1.64
7/28	1630	13-15	61	6.5	9	10	10	10	10	9.8 ± 0.45
7/29	1420	13-15	33	6.5	9	8	8	8	8	8.2 ± 0.45
7/28	1715	16-18	57	6.5	6	10	9	8	10	8.6 ± 1.67
7/29	1507	16-18	31	6.5	9+	10	9	10	10	9.6 ± 0.55
7/29	1100	01	47	6.4	10	10	9	9	8	9.2 ± 0.84
DSS Toxicant - 10 ppm[3]					8	9	10	8		8.8 ± 0.96
DSS Toxicant - 20 ppm[3]					1	0	0	1		0.5 ± 0.58

1 Suspended solids in original sample in mg/ℓ.
2 10 = 100 percent survival, + means young *Daphnia* were observed in this beaker at the end of the bioassay.
3 DSS standard toxicant data taken at 48 hr.

Table N2
Survival of *Daphnia magna* Exposed to Unfiltered Buffalo River Water - 96 Hr, 30 July - 4 August

Date	Time	Station	SS	pH	Percent Survival[1]					Mean
Controls				6.9	10+	8+	10+	10	9+	9.4 ± 0.89
7/30	1445	01	143	7.1	7	8+	10+	8	6	7.8 ± 1.48
7/30	1653	16-18	32	6.9	10+	10	10	8+	10	9.6 ± 0.89
7/30	1720	16-18	74	7.2	6	10	10+	10	10	9.2 ± 1.79
7/31	1551	16-18	356	7.2	10+	6	8	10	5	7.8 ± 2.28
7/31	1210	01	336	7.3	8+	6	8	8	8	7.6 ± 0.89
7/31	1651	16-18	316	7.3	10	10	10	10	8	9.6 ± 0.89
8/03	1200	01	176	7.7	10+	10	10	10	7	9.4 ± 1.34
8/03	1559	16-18	91	7.7	6	10	8	8	7	7.8 ± 1.48
8/04		16-18	244	7.3	8	4	3	8	7+	6.0 ± 2.35
8/04	1545	13-15	630	7.4	8	3	4+	6+	2	4.6 ± 2.41

[1] 10 = 100 percent survival, + means young *Daphnia* were observed in this beaker at the end of the bioassay.

Table N3
Second Test, Survival of *Daphnia magna* Exposed to Unfiltered Buffalo River Water - 96 Hr

Date	Time	Station	Percent Survival[1]					Mean
Controls			7	5	7	8+	8	7.0 ± 1.23
7/30	1445	01	4	3	4	9	7	5.4 ± 2.51
7/30	1653	16-18	9	4	6	8	7	6.8 ± 1.92
7/30	1720	16-18	9	8	6	9	8+	8.0 ± 1.23
7/31	1551	16-18	9	5	6	5	8	6.6 ± 1.82
7/31	1210	01	7	6	9	6	7+	7.0 ± 1.23
7/31	1651	16-18	9	6	6	6	5	6.4 ± 1.52
8/03	1200	01	5	8	8	6	10	7.4 ± 1.95
8/03	1559	16-18	7	10+	9	8	7	8.2 ± 1.30
8/04	1630	16-18	7	6	4	5	6	5.6 ± 1.14
8/04	1545	13-15	10	7	8+	6	8	7.8 ± 1.48

[1] 10 = 100 percent survival, + means young *Daphnia* were observed in this beaker at the end of the bioassay.

Table N4
Survival of *Daphnia magna* Exposed to Unfiltered Buffalo River Water - 96 Hr, 6-7 August

Date	Time	Station	SS[1]	pH[1]	Percent Survival[2]					Mean
Controls				7.7	8	6	5	8	2	5.8 ± 2.49
Controls II				7.3	8	4	8+	7	4	6.2 ± 2.05
8/06	1653	16-18	34	6.8	8	2	6	5+	0	4.2 ± 3.19
8/06	1530	01	145	6.7	0	6+	8+	6	3	4.6 ± 3.13
8/08	1700	16-18	8	6.8	5+	4	5	7	0	4.2 ± 2.59
8/08	1345	01	17	6.7	5	0	7+	5	7+	4.8 ± 2.86
8/07	1015	01	197	6.8	8	4	3	8+	8+	6.2 ± 2.49
8/07	1700	15-18	35	6.9	9+	5	8	6	8+	7.2 ± 1.64
DSS Toxicant - 5 ppm#					10	9	10	10	7	9.2 ± 1.30
DSS Toxicant - 10 ppm#					9	9	8	8	10	8.8 ± 0.84
DSS Toxicant - 20 ppm#					0	0	2	3	1	1.2 ± 1.30

Note: # = DSS standard toxicant data taken at 48 hr.
[1] Suspended solids in original sample in mg/ℓ.
[2] 10 = 100 percent survival, + means young *Daphnia* were observed in this beaker at the end of the bioassay.

Table N5
Survival of *Daphnia magna* Exposed to Filtered Buffalo River Water - 96 Hr, 24-29 July

Date	Time	Station	Percent Survival[1]					Mean
Controls			9+	10	9	8	10+	9.2 ± 0.84
7/24	1300	13-15	7	8	7	8	6	7.2 ± 0.84
7/24	1600	16-18	5	7	6	7	5	6.0 ± 1.00
7/28	1630	13-15	5	7	9	5	4	6.0 ± 2.00
7/29	1420	13-15	10+	6	9	8	8	8.2 ± 1.48
7/28	1715	16-18	7	5	8	7	6	6.6 ± 1.14
7/29	1507	16-18	9	7	8	9	9	8.4 ± 0.89
7/29	1100	01	6	5	6	5	6	5.6 ± 0.55

[1] 10 = 100 percent survival, + means young *Daphnia* were observed in this beaker at the end of the bioassay.

Table N6
Survival of *Daphnia magna* Exposed to Filtered Buffalo River Water - 48 Hr, 30 July - 4 August

Date	Time	Station	Percent Survival[1]					Mean
Controls			10	7	8	10	8	8.6 ± 1.34
7/30	1445	01	7	8	7	9	9	8.0 ± 1.00
7/30	1653	16-18	8	7	9	10	9	8.6 ± 1.14
7/30	1720	16-18	9	9	10	9	8	9.0 ± 0.71
7/31	1551	16-18	10	10	6	7	7	8.0 ± 1.87
7/31	1210	01	7	10	8	9	10	8.8 ± 1.30
7/31	1651	16-18	9	10	10	8	9	9.2 ± 0.84
8/03	1200	01	8	6	5	9	9	7.4 ± 1.82
8/03	1559	16-18	7	10	10	8	10	9.0 ± 1.41
8/04	1630	16-18	9	8	8	9	9	8.6 ± 0.55
8/04	1545	13-15	10	6	9	9	7	8.2 ± 1.64

[1] 10 = 100 percent survival.

Table N7
Second Test, Survival of *Daphnia magna* Exposed to Filtered Buffalo River Water - 96 Hr

Date	Time	Station	Percent Survival[1]			Mean
Controls			6	10	8	8.00 ± 2.0
7/30	1445	01	10	10	6	8.67 ± 2.3
7/30	1653	16-18	6	6	10	7.33 ± 2.3
7/30	1720	16-18	10	6	10	8.67 ± 2.3
7/31	1551	16-18	10	6	8	8.00 ± 2.0
7/31	1210	01	10	4	8	7.33 ± 3.1
7/31	1651	16-18	8	8	8	8.00 ± 0.0
8/03	1200	01	10	10	10	10.00 ± 0.0
8/03	1559	16-18	6	8	4	6.00 ± 2.0
8/04	1630	16-18	10	10	6	8.67 ± 2.3
8/04	1545	13-15	10	10	10	10.00 ± 0.0

[1] 10 = 100 percent survival.

Table N8
Survival of *Daphnia magna* Exposed to Filtered Buffalo River Water - 96 Hr, 6-7 August

Date	Time	Station	Percent Survival[1]				Mean
Controls			8	7	9	8	8.00 ± 0.82
8/06	1653	16-18	7	7	8	6	7.00 ± 0.82
8/06	1530	01	7	6	8	6	6.75 ± 0.96
8/08	1700	16-18	8	7	9	8	8.00 ± 0.82
8/08	1345	01	8	8	9	9	8.50 ± 0.58
8/07	1015	01	7	6	8	5	6.50 ± 1.29
8/07	1700	15-18	6	7	5	7	6.25 ± 0.96

[1] 10 = 100 percent survival.

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13. ABSTRACT *(Maximum 200 words)*

In July/August 1992, the Corps of Engineers Buffalo District conducted a demonstration of equipment for dredging contaminated sediments. Several thousand cubic yards of sediment were removed from outside the Buffalo River Federal navigation channel limits using three dredge types: (1) open bucket, (2) enclosed bucket, and (3) submersible pump. The effectiveness of a silt screen deployed downstream of the dredge to reduce suspended sediment transport was also evaluated. Extensive sediment and water column monitoring and sampling were conducted during the 2-week demonstration as part of the effort to determine sediment resuspension rates and contaminant releases associated with the dredging operations. Water column samples were analyzed for total suspended solids, total organic carbon, PCBs, PAHs, metals, ammonia, and pH. A water column bioassay test using *Daphnia magna* was also performed to assess toxicity effects of the dredging operation. Results of this study were used to assess and refine techniques and laboratory tests that have been previously developed by the Corps of Engineers to predict sediment resuspension rates and contaminant releases. In another phase of the study, the Bureau of Mines demonstrated the use of polyelectrolytes for rapid removal of suspended solids from a dilute dredged material slurry.

14. SUBJECT TERMS

Buffalo River	Dredging	Suspended sediment
Contaminated sediment	Remediation	Water quality
Dredged material	Resuspension	

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